INFORMATION RESOURCES ON

WOOD-FRAME CONSTRUCTION PRACTICE

IN NORTH AMERICA:

an annotated bibliography

RESSOURCES D'INFORMATION SUR

LA PRATIQUE DE LA CONSTRUCTION À OSSATURE BOIS

EN AMÉRIQUE DU NORD :

bibliographie analytique

David Monteyne
Jennifer O'Connor

Forintek Canada Corp.

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Western Division/Division de l'Ouest
2665 East Mall
Vancouver, B.C. V6T 1W5
Tel/Tél: (604) 224-3221
FAX/Télécopieur: (604) 222-5690

Eastern Division/Division de l'Est
319, rue Franquet
Sainte-Foy, Québec G1P 4R4
Tel/Tél: (418) 659-2647
FAX/Télécopieur: (418) 659-2922

Internet: http://www.forintek.ca

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INFORMATION RESOURCES ON WOOD-FRAME CONSTRUCTION PRACTICE IN NORTH AMERICA:

RESSOURCES D'INFORMATION SUR LA PRATIQUE DE LA CONSTRUCTION À OSSATURE BOIS EN AMÉRIQUE DU NORD :

an annotated bibliography — *bibliographie analytique*

David Monteyne
Jennifer O'Connor

Forintek Canada Corp.

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Summary

This document is a list and review of 170 current published materials and web sites that deal with the design and construction of most types of wood buildings in North America, including both light and heavy timber framing. The focus is the structural use of wood rather than exterior or interior finishing, millwork, shingles, or other such components, although many books in this list cover all these topics. This bibliography also includes some items on related issues such as material properties, building systems, wood use, sustainable design, indoor air quality, new products, marketing, research, and testing. Most of the listings are recent, generally limited to those published since 1980, and largely restricted to publications originating within North America.

Commentary provided for each item includes a description of the content and intended audience, as well as an opinion regarding quality of the document and its likely effectiveness in influencing the practice of wood design and construction.

The literature search was aimed at materials targeted to architects, engineers, professional builders, and owner-builders/clients. This exercise is one step in examining how these specifiers get their information about wood and wood construction, and what is the nature and quality of that information.

Also included is a brief history of wood building in North America.

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Preface

This publication is an annotated bibliography on wood frame construction in North America. It lists published materials and web sites that deal with the design and construction of most types of wood buildings, including both light and heavy timber framing. Log houses and prefabricated structures have been omitted from this review, and only the key volumes on other, less common methods of construction, such as pole framing, have been included. The focus is on the structural use of wood rather than exterior or interior finishing, millwork, shingles, or other such components, although many books in this list cover all these topics.

This bibliography also includes some items on related issues such as material properties, building systems, wood use, environmental issues (both "green" and indoor air quality), new products, marketing, research, and testing. These issues are necessarily covered in a less comprehensive manner than the structural use of wood, but an attempt was made to abstract some of the key works and overviews on these other subjects.

The timeframe for publications included is limited to the last twenty years, although occasional items precede 1980. In almost all cases, the most recent edition of any book was the one consulted. For the most part, publications originating outside of North America are not included unless they are known to be widely used here, or they seemed to be key publications.

The literature search was conducted in a manner that discovered materials aimed at different audience groups who use wood in construction: architects, engineers, professional builders, and owner-builders/clients. The abstracting of the items reflects a desire to determine how these specifiers get their information about wood and wood construction, and what is the nature and quality of that information.

It was found that many items are addressed to, or would be useful to, more than one specific building profession. To allow for this fact in this bibliography, the items are organized into thematic categories: works that focus on wood products and properties; design and construction manuals and textbooks; design data; descriptions of research, testing, and innovation; and web sites. The abstracts themselves should reveal which audience for whom the particular item is useful. Within the thematic sections are sub-categories of books and articles. Short research reports and special publications, since they have no serial data, are categorised as books. Web sites are presented in a separate section, as they often cover diverse topics through links to information.

We omitted the numerous architectural journal articles on buildings that happen to be made out of wood, but where the focus of the article is not structural design. Our task was to review material intended to *directly* convey information about wood systems, and these types of articles offer designers minimal application information. While we acknowledge the great value of published examples in potentially influencing architects to use wood, this is an indirect effect from the perspective of our project objectives.

On the research side (as opposed to the design side), there are many engineering studies on shear walls, diaphragms, nailing patterns, trusses, materials tests, connections, products, and so on, which have not been abstracted due to their specificity. Another topic for which there are numerous studies is the performance of wood frame buildings in natural disasters. For the most part, these disaster reconnaissance studies have been left off the list, as their conclusions are ultimately recorded in building and design manuals, standards, and codes.

Engineering conference proceedings were examined and it was decided that they would not be abstracted, other than a few sample entries classified as articles in this bibliography. Conference papers tend to present highly specific research not of direct use to the practitioner, often based on international conditions and test sites. Significant conference papers, or the information in them, would surely be published again in book or article form directed at the designer.

Organisations such as—to name a few of the larger ones—the Canada Mortgage and Housing Corporation; the United States Forest Products Laboratory; and the APA, the Engineered Wood Association, all have publications too numerous to be abstracted here. Their publications most pertinent to our topic are included, as well as ones which may serve as representative samples of the types of information provided. Please refer to the web sites listed in this bibliography for more information on these kinds of organisations and their publications.

Proprietary design data, and other product literature published by manufacturers or their representative organisations, is not included. This information is available most readily via the web sites of the manufacturer or organisation. Only web sites of organisations and associations were examined for this project. There are many manufacturers of

wood products whose sites are easily accessible from the home pages of their representative organisations, or from commercial web sites which list, link, and sometimes review building products. See this bibliography for some of these sites, but keep in mind that the web changes quickly—some sites are updated daily with useful new information, some are orphaned soon after their genesis, and others just disappear.

During the course of this research, and from many of the sources listed in this bibliography, information has been collected on the history of wood building in North America. This has been summarised briefly and is included in the appendix at the end of this bibliography.

In the bibliographic entries, the abstract is preceded by the reference information, with the book or journal title in bold print. In the case of an article, its title is listed first in a regular font, without capitalisation, to distinguish it from the journal's title. The author is always the second line of the entry. For books, the place, publisher, and year are included in the last two lines. For articles, the journal issue's volume and number, separated by a colon, are followed by the year.

For the most part, the items abstracted in this bibliography have been consulted at three locations: Forintek's Western Library, the University of British Columbia Library, and the Vancouver Public Library. Therefore, most of them should be available in local university and public collections. This bibliography is comprehensive, but the user should realise that there may be materials that have been missed in the search. If so, please send suggestions for further entries to:

Jennifer O'Connor
Forintek Canada Corp.
2665 East Mall
Vancouver, BC
V6T 1W5

jennifer@van.forintek.ca

tel: 604-222-5718
fax: 604-222-5690

Wood Products and Properties

Books

Wood Reference Handbook

Canadian Wood Council
Ottawa: Canadian Wood Council
1995

This book "is intended to demonstrate the potential for using wood products in all types of North American buildings. It begins with basic information about wood products and then describes basic structural materials, means of connection, and resulting wood structural systems. Information about exterior- and interior-use wood products comes next, followed by supplemental information about protecting wood and designing to meet fire safety requirements." An introduction to wood and wood building for architects—for instance, it discusses appearance, common uses, and standard sizes of wood products, and refers the architect to technical specialists/manufacturers/codes, and to the CWC Wood Design Manual. The book remains at a general level, without specific how-to information, although there is typically enough detail for an architect to know good and bad practices to look for during site inspection. The book covers all uses of wood as a building material, not just frame construction. Informative, clearly written, good diagrams, promotes wood on a practical (not hyperbolic) basis.

Wood Handbook: Wood as an Engineering Material

Forest Products Laboratory
Washington: U.S. Dept. of Agriculture
1999

The sixth expanded and revised edition of the classic handbook first published in 1935. "Summarizes information on wood as an engineering material. Presents properties of wood and wood-based products of particular concern to the architect and engineer [the latter more so]. Includes discussion of designing with wood and wood-based products along with some pertinent uses."The section on properties is much more extensive than the section on design. The former is very detailed with information on different species and their biological, physical, and mechanical properties, availability, grading rules, moisture contents, decay, preservation, and manufacturing processes. The section on wood use in design is limited to a very general overview of building construction and other uses, with occasional illustration of a construction detail, plus a section concerning fire protection. It goes briefly into design calculations, but mainly for the design and manufacture of individual members.

Engineered Wood Products: A Guide for Specifiers, Designers, and Users

Stephen Smulski
Madison: PFS Research Foundation
1997

By far the best overview of these relatively new and unknown building materials. Not overly technical, and generally directed at architects. Chapters on the various products—glulam, plywood, metal plate connected (MPC) trusses, I-joists, oriented strand board (OSB), and structural composite lumber (SCL)—include information on their history, manufacturing, grading/testing and design values, finishing, preservative treatments, and much on applications. Other chapters deal with engineered wood products and fire protection, long term performance, quality assurance, building codes, and a good discussion of load and resistance factor design (LRFD) in comparison to allowable stress design (ASD).

Wood as a Building Material: A Guide for Designers and Builders

W. Wayne Wilcox, Elmer E. Botsai, Hans Kubler
NY: John Wiley & Sons
1991

This is written in textbook style, and has a very scientific approach: wood biology, pest biology, manufacturing processes, engineering qualities of wood products, decay and preservation. Perhaps too scientific for its intended audience. Presents all different arguments about contentious points in the scholarly tradition—therefore, is not very direct. Uses words like "hygroscopic" without any accompanying definition. Includes kernels of building wisdom among lots of science. This book is not about construction or framing at all, except for the final, brief section that

deals with two construction issues, namely keeping out water and termites. Supersedes Kubler's previous book, *Wood as a Building and Hobby Material* (1980).

The Science and Technology of Building Materials

Henry J. Cowan, Peter R. Smith
NY: Van Nostrand Reinhold
1988

A rather fascinating book that describes all building materials from the level of atoms to their processed use in construction. The book begins with a broad discussion of the strength, stability, and absorption (of water, sound, heat, etc.) properties of materials in general, with some specific materials used as examples. The second half of the book then delves in more detail into each type of material and its properties. Compared with its competitors, wood receives equally studied, straightforward, and informative coverage. The conclusion is an overview of factors affecting the choice of materials in construction, but in general, the book does not reflect that typical modern buildings are made from a melange of materials. Note that the authors are Australian, and this book occasionally reflects this in its terminology, illustrations, and methods of building.

Mechanics of Wood and Wood Composites

Jozsef Bodig, Benjamin A. Jayne
NY: Van Nostrand Reinhold
1982

A very scientific study of wood which attempts to present biology for engineers and architects, and mathematics and engineering for forestry students. Mainly for engineers, this book provides them with information on the mechanical properties of wood to be applied in design, and explains testing procedures that determine design values and so on.

A Pattern Language

Christopher Alexander, et al.
NY: Oxford
1977

This book was consulted due to its influence in architecture schools for the twenty years after its publication. It discusses materials and their properties hardly at all (Section 207, "Good Materials"). It divides materials into two general categories, bulk (structural) and secondary (partitions, finishes). Wood is deemed inappropriate as a bulk material (lightweight concrete is promoted) due to forest mismanagement which has turned it into a precious material, suitable only for secondary detailing. The authors exclude any bulk materials that are expensive, difficult to work, or limited in reserves, including aluminium, rolled steel panels, prestressed concrete, plate glass, and structural lumber.

Wood Technology in the Design of Structures, 5th ed.

Robert J. Hoyle Jr., Frank E. Woeste
Ames: Iowa State University
1989

Another one of the good textbooks in the field, aimed at engineering (and architecture) students, and including examples, exercises, and answers. Spends more time on wood properties, under the assumption that the basics of structural design are similar among the various materials, and that it is material properties that make the difference. Gives more attention than other books to the properties and uses of plywood and glulam. Is written specifically in reference to the latest (1986) National Design Specification for wood.

Builder's Guide to New Materials and Techniques

Paul Bianchina
NY: McGraw-Hill
1997

An interesting book in that, despite the rather general title, it mainly focuses on engineered wood products for structural uses (with only one chapter on non-wood products). A builder's version of Smulski (1997). Introduces the development and necessity of engineered wood through the notion of disappearing forests and degenerating lumber quality. Covers the types of engineered wood products, their manufacturing process, connections, computer design

software, specifying, and their proper storage, handling, and installation. Uses research information from manufacturers without becoming an advertisement in itself. Written in a direct, colloquial manner to appeal to builders.

Understanding Wood: A Craftsman's Guide to Wood Technology

R. Bruce Hoadley
Newtown, CT: Taunton
1980

Although really directed at woodworkers such as carvers and furniture makers, this often-cited book thoroughly presents wood biology, and especially mechanical properties, in an accessible manner. Probably the clearest of all the books written on this subject. Wood-frame construction is briefly mentioned at certain points, but this book is most useful for understanding the unique characteristics of wood—moisture, cell structure, grain, defects, strength, etc.—and how they affect wood in use.

The Healthy House, 3rd ed.

John Bower
Bloomington, IN: The Healthy House Institute
1997

A very interesting book that describes in detail how to buy or build a healthy house, or cure a sick one. This book begins with an overview of healthy housing issues, then talks about considerations in purchasing a second-hand house or a lot. In dealing with the healthy house itself, the book discusses the sometimes complicated and difficult process of planning construction, from the initial layout of the site, to the choice of all mechanical systems, barriers, types of foundations, and the implications of all the different choices. The largest portion of the book is then devoted to materials and components. Generally positive towards wood as a natural material, though it notes allergies to certain species, and other problems experienced by sensitive people. Some aspects of wood are severely criticized, especially the preservatives used for treating it, and the glues used for making engineered wood products. In the latter case, the author recognizes that the glue used in most plywood and OSB today outgases much less than the older urea formaldehyde glues still used in most particleboard (for instance). Discusses the health aspects of different solutions for wood pests, and, indeed, notes that the major disadvantage of wood for framing is its susceptibility to termites, and the often toxic termite control measures taken by builders or required by mortgage dealers. Describes steel framing as the main alternative, but does not particularly favour it over traditional softwood framing.

Handbook of Alternative Materials in Residential Construction

R.T. Bynum Jr., D.L. Rubino
NY: McGraw-Hill
1998

This book is mainly directed at owner/developers, but could be a source for builders and designers as well. Presents two to three innovative materials/systems in each topical chapter on foundations, walls, roofs, HVAC, etc. Dimension lumber is generally denigrated, and wood appears only as engineered wood products, specifically I-joists, glulam beams, and various composite panels. This polemical book often argues for these new systems purely on the basis of their being "innovative," without solid research to back up the argument. For example, a subject like embodied energy is not delved into when the authors advocate steel studs for light frame construction, and the thermal bridging of these studs is glossed over. In general, wood construction is painted as a thing of the past.

Articles

How good is wood?

Timothy B. McDonald
Architectural Record
178:13
1990

A series of four short articles on the state of the wood industry and the use of wood in architectural design. Background for the discussion is the disappearing forests and environmentalism among activists and architects. Sawn lumber is predicted to become more expensive and of lower quality—a discussion of grading standards relates to

the issue of quality. Concludes by describing engineered wood products as a positive turn in the industry due to their efficient use of resources and their engineered performance, though the author says that many of these products have not yet undergone long-term testing.

Framing techniques change to match resource quality

Dana Holbrook
Architectural Record
183:9
1995

Discusses the disappearance of quality lumber and the dilemma of trying to specify it due to its unpredictability in price and availability. Contractors, however, are unfamiliar with engineered wood products and light steel framing. Cautions about possible variability in the properties of engineered wood products as well. State of forest industry is discussed in relation to harvesting younger, farmed trees.

Is wood or metal "greener"?

Nadav Malin
Architectural Record
183:9
1995

Compares the two materials as framing members for industry, extraction, processing, thermal bridging, and recyclability. Conclusion is noncommittal to either material, but says not to judge wood merely on the basis of industrial forest practices.

Engineered lumber's strengths

Elizabeth S. Padjen
Architecture
86:2
1997

Brief article outlining the manufacturing processes (with diagrams), properties, and uses of glulam, structural composite lumber, laminated veneer lumber, and laminated strand lumber. Notes performance and cost of engineered wood products in comparison to sawn lumber, but not to other materials.

New life for old wood

Reed Kroloff
Architecture
85:10
1996

Explores recent growing use of heavy timbers and other wood reclaimed from older structures. Architects and suppliers of reclaimed wood give their positive views of the structural soundness and beauty of this old wood. Cautions are given regarding lack of grading/testing history for used wood and finite supply of old structures. Written in context of 1990s environmentalism. Followed by short descriptions and illustrations of three houses using recycled wood.

Engineering nature: diminishing sources for natural wood are leading to manufactured alternatives

Marc S. Harriman
Architecture
80:9
1991

Brief article outlines types and uses of engineered wood products and refers architects to updated wood design specifications produced by the Western Wood Products Association. Illustrated by descriptive sidebars featuring three projects in British Columbia utilizing engineered wood products: Forest Engineering Research Institute of Canada, Vancouver; Seabird Island School, Agassiz; and Graduate Students Society Centre, University of Victoria.

Technical: wood as a primary structure

Gary Williams
Canadian Architect
41:7
1996

Outlines some of the perceived drawbacks that have prevented more specification of wood in nonresidential projects, and some of the recent developments that should make it more attractive as a building material. Briefly described is the significance and usefulness of these recent developments, which include engineered wood products, wood design software, and the glulam rivet. Unfortunately, the author was not given enough space to impart more than general information.

Reinforced glued laminated timber

Bruce D. Pooley
Civil Engineering
66:9
1996

Charts the manner by which reinforced glulam has, rapidly in the early 1990s, gained widespread commercial acceptance due to a major testing program and to early successful uses in timber bridges and buildings. Informs engineers of some of the design considerations when using the material.

Forest products for building construction

J.D. McNatt, W.L. Galligan, G.E. Hans
Wood and Fiber Science
16:2
1984

Building components and wood products are summarised thoroughly for forest industry readers. All wood structural components are covered. This article is good for the state-of-the-art in 1984.

Emerging nonwood building materials in residential construction

Henry Spelter
Forest Products Journal
46:7-8
1996

"Recent fluctuations in timber markets have contributed to an upsurge in the volatility and level of lumber prices, which has stimulated interest among builders in alternative building materials. This report describes the development of steel, concrete, and sandwich panel wall systems, and compares their costs to that of wood-frame construction... [While] wood systems continue to offer the most economical method of construction... lifetime cost savings can favour nonwood systems." Good summary of alternative building methods and materials.

Wood Design Focus

Individual articles not abstracted

"A Journal of Contemporary Wood Engineering." The focus of this quarterly is the technological aspects of designing with wood, particularly wood buildings, and also the practical application of wood science (for instance, in forensics). This is not a glossy magazine, but more like a scientific update newsletter directed at engineers and wood specialists with theme issues such as the latest research on durability of wood buildings, connections, moisture transport in buildings, trusses, etc. Published by the Forest Products Society in Madison since 1989.

Design and Construction Manuals and Textbooks

Books

Wood Design Manual

Canadian Wood Council
Ottawa: Canadian Wood Council
1995

This book demonstrates how to use wood products in all types of buildings, with specific reference to Canadian codes. It presents the design tables for calculating the specifications of members (with examples), and other technical information necessary to the designer (and architect or engineer). Unlike other design manuals it is not chronologically organized (i.e., from foundations to roof); rather, the chapters deal with types of members, loads, bearing, fasteners, applications, shearwalls, fire safety, and reference information. It concludes with a commentary and the complete text of the CSA code, Engineering Design in Wood (Limit States Design). *The Wood Design Manual* is basically the bible for this field, at least in Canada.

Introduction to Wood Design

Canadian Wood Council
Ottawa: Canadian Wood Council
1999

Intended to be used in conjunction with the *Wood Design Manual*, this book is directed particularly at engineering students (and could be of use to architecture students) to be used as a text in wood design courses. It was created with the input of wood design professors and therefore reflects the content and methods of engineering coursework. Introductory chapters cover limit states design, loads, and structures in general (not specifically wood), and the rest of the book combines elements of the *Wood Design Manual* with some of the background information on wood and wood products that is found in the *Wood Reference Handbook*. The final chapter presents a sample warehouse/office building (with a stated use and location), and covers all the main design calculations from snow load to anchorage.

Introduction to Wood Building Technology

Canadian Wood Council
Ottawa: Canadian Wood Council
1997

"A summary in revised format of information found in the [CWC] Datafiles." Seems to largely duplicate their other books. It is intended as a guide to construction for the designer and inspector. Lots of information on architectural detailing regarding such things as dimensional change, insulation, barriers, etc.

Canadian Wood-frame House Construction

Canada Mortgage and Housing Corporation
Ottawa: Canada Mortgage and Housing Corporation
1997

First published in 1967, this edition claims (probably justly) that it "has been the primary means by which builders, carpenters and students of housing technology have learned about wood-frame house construction in Canada. This publication continues to be the most widely used reference in the field, in community colleges and in many university architecture programs." That said, the nature of the presentation in this book suggests a good portion of its audience could be the client or self-builder, since the topic is explained beginning with very basic precepts such as permits and inspections, and financing. Generally, things are explained to the level of the layperson, but builders would also find this quite useful as a reference manual for minimum spacing and sizing, and complicated construction details like flashing, corners, eaves, vapour barriers, etc. Though the text is not overly technical, many tables for spans, nailing, and the like are included in the appendix. "The organization of [the book] corresponds to the construction sequence for a typical Canadian house… and reflects typical practices." Sidebars in this edition give extra information on healthy housing (including green issues), and on planning ahead and double-checking in the building process.

Wood Frame House Construction

Gerald E. Sherwood, Robert C. Stroh
Washington: National Association of Home Builders
1988

The American version of the CMHC publication with essentially the same title (1997, above), this was first published in book form in 1955 (which originally was the model for the Canadian version). Takes a similar approach to the CMHC version, beginning with local regulations, financing, etc., and follows the chronological sequence of house construction. Covers the basics in a detailed manner. A final chapter on special topics includes protection against decay and noise, lumber grades, weather loading, and other general considerations. Throughout the book, considerable attention is paid to energy and resource efficiency, and to overall planning of the design and construction process with these in mind. Interestingly, this book ignores balloon framing, focusing entirely on platform.

Wood-frame House Construction

L.O. Anderson, William Oberchulte
Carlsbad, CA: Craftsman
1992

A revised reprint of the early handbook first written by Anderson in 1955, this version has been minimally altered, unlike the official, modernized edition by Sherwood and Stroh (NAHB, 1988, above). This reprint does not look at a house holistically, but dives right in to the excavation, then describes house building as a series of finite steps. Chapters are not introduced with general information and are rather poorly organized, though the basics of the topic are presented.

Design of Wood Structures ASD, 4th ed.

Donald E. Breyer, Kenneth J. Fridley, Kelly E. Cobeen
NY: McGraw-Hill
1998

The latest edition of this engineering textbook brings it up to date with 1997 changes to the National Design Specification and the Uniform Building Code (and assumes the reader's possession of those two publications). This text focuses on allowable stress design (ASD) because it is still the popular choice among design professionals. However, a separate edition of this book is being prepared based on load and resistance factor design (LRFD), which the authors predict will eventually replace ASD. Concepts are well introduced in this book, and it seems to explain loads and forces more clearly than other texts, along with basics like soil conditions, the technical complexities of seismic design, and other advanced topics. Wood properties are presented with illustrated examples of what they actually mean to design. Several chapters on connections (types, design, hardware), and extensive information on design with glulam and plywood; but other engineered wood products are covered to a much lesser extent. Many study problems for students are provided.

Wood Engineering and Construction Handbook, 3rd ed.

Keith F. Faherty, Thomas G. Williamson
NY: McGraw-Hill
1999

Probably the most comprehensive handbook on this topic, it claims that "you'll refer to it practically every day!" Each topic—from the usual ones like wood properties, members, and connectors, to more advanced subjects like shearwalls, arches and domes, bridges, formwork, wood-metal composites, wood foundations, and adhesives—is thoroughly covered by a different expert. Included in each chapter is "extensive basic product information, design data, and design examples" as well as design equations and procedures. The level of detail achieved on each topic is beyond that seen in textbooks and other design manuals. Based on the 1997 National Design Specification for wood, and presenting information on a range of engineered wood products.

Fundamentals of Building Construction, 3rd ed.

Edward Allen
NY: Wiley
1998

This is the classic textbook (there are review questions and exercises with each chapter) for architectural students and is perhaps found in many architect's offices as well. It is written in a very practical and clear manner presenting what the architect needs at the drawing board and in the field. Excellent illustrations including step-by-step drawings and photos. Devotes one chapter to each of the following: wood properties and products; heavy timber construction; and wood light-frame construction. Quite positive towards wood and shows how its natural defects can be overcome by knowledgeable architects and builders. Highlights wood's beauty, environmental aspects, the flexibility of light wood frame construction, and the usefulness and non-combustibility of heavy timber construction. Very detailed about engineered wood products. The book's main concern with light wood frame construction is "not its combustibility or its tendency to decay, but its ability to be reduced to the irreducibly minimal—scarcely human—building system." This said in reference to the cheapest suburban tract houses using minimum materials and detailing. One advantage of this over the many other construction handbooks is its equal reference to Canadian as well as American codes and standards.

The Architect's Studio Companion, 2nd ed.

Edward Allen, Joseph Iano
NY: Wiley
1995

For initial building design exploration, presents rules of thumb bases for decision making on codes, structures, mechanical, and egress. Section on structure gives equal and balanced information on all materials and types of construction, and their pros and cons for different building types. Wood actually gets a few more pages than any other material.

Building Design and Construction Handbook, 5th ed.

Frederick S. Merritt, Jonathan T. Ricketts
NY: McGraw-Hill
1994

This large tome covers every material, system, and type of construction, as well as other topics related to building, and is directed at the architect (and perhaps the engineer, though the information is likely not specific enough for these professionals). The writing and few illustrations are much less clear than Edward Allen's *Fundamentals* (1998, above), and this book takes a much more technical approach. It includes many formulae and mathematical calculations for determining design values of individual members. Refers reader continuously to codes and standards. The section on wood as a material is very basic and, other than plywood, does not mention engineered wood products at all, causing one to question how up to date this most recent edition is. The section on wood construction mentions engineered wood products in passing, as well as all the main elements of wood frames, sheathing, etc. These subjects are presented in a brief, technical manner—as a string of facts without much interpretation for the reader.

Building Construction: Materials and Types of Construction, 5th ed.

Whitney Clark Huntington, Robert E. Mickadeit
NY: Wiley
1981

This all-encompassing guidebook compares well to Allen's *Fundamentals* in its clear description and illustrations. This book is written mainly with the design student in mind. Covers building systems, materials, hardware, methods, and finishes; the section on wood construction is comprehensive and informative, without being overly technical. The wood section covers properties and processing, connectors, wood framing, timber framing, and what the codes define as ordinary construction, where wood framing combines with other materials used for exterior walls. Also covered are floors and roofs, columns/beams, glulam and lamella arches. There is also a 6th edition of this book (1987), which we were unable to locate.

Handbook of Architectural Technology

Henry J. Cowan, ed.
NY: Van Nostrand Reinhold
1991

Another useful reference book on all building materials and systems. Less illustrations than Allen's *Fundamentals* (1998, above), but more specific information, particularly on the science and mechanical properties of building materials. The timber/wood structural section is fairly detailed in its presentation.

Building Construction: Principles, Practices, and Methods

Glenn M. Hardie
NJ: Prentice Hall
1995

Focuses on describing construction methodology for novice architects and engineers, so it does not go into details of wood frame construction, just the scheduling and processes, with a little information on materials and techniques. Equal space is given to finish and rough carpentry, and the latter's importance for shoring and concrete formwork is emphasised. The organization of the book is based on the MasterFormat reference system of construction information, and is therefore a bit tortured and confusing: for instance, the wood section opens with information on adhesives preceding the basic descriptions of rough carpentry.

Dwelling House Construction, 5th ed.

Albert G.H. Dietz
Cambridge: MIT Press
1991

The subject of the book being small buildings, it deals with wood construction extensively above the foundations (permanent wood foundations are also briefly mentioned). Wood properties are introduced in a less clear manner than other handbooks, but the section on framing is quite good, with very good diagrams, and explains why some traditional practices came to be, and how things are commonly done today. Section on steel framing is very brief, but brick construction gets a look. The book is directed at architecture students, but in its detailed overview from site inspection to finished house, it could be used by do-it-yourself builders.

Graphic Guide to Frame Construction: Details for builders and designers

Rob Thallon
Newtown, CT: Taunton Press
1991

Aims to be the Architectural Graphics Standards for wood frame construction. Is written in an accessible manner for architects and owner/builders, but makes some assumptions of the reader's knowledge of certain things (like loads and R-ratings), partly due to its emphasis on visual rather than textual information. Presents a large number of alternatives for different building systems without fully explaining their different uses; therefore, is ideal if you want to know how to draw or build the system you have already decided on. Is not really a how-to manual, but is a fairly detailed introduction to the techniques, terminology, and materials of wood frame construction. Seems to miss some good practices. Refers reader continuously to engineers or other sources for real calculations.

Structural Concepts and Systems for Architects and Engineers, 2nd ed.

T.Y. Lin, Sidney D. Stotesbury
NY: Van Nostrand Reinhold
1988

This is a fairly popular (translated into Chinese, 1999) one of several textbooks (e.g. *Structures for Architects; Architectural Structures*) available in this genre which looks at how architects can relate their concepts to real structures and modes of construction. This type of book tends to focus less on materials than on general structural precepts of loads and forces. When materials are discussed it is almost always steel and concrete, no doubt because these are the materials that seem most relevant to the large-scale buildings worthy of the attention of architects and engineers. In this particular book, the chapter on construction contains sections on steel, as well as in-place and pre-cast concrete, but not on timber. Other books like this usually mention glulam beams or some aspects of timber engineering in a brief manner, as examples in a more general discussion of structural properties.

Structural Engineering Handbook, 3rd ed.

Edwin H. Gaylord Jr., Charles N. Gaylord
NY: McGraw-Hill
1990

General, commonly used, handbook of structures and structural materials. Very cursory look at the engineering design elements of timber structures. Includes some of the key tables and formulae a designer may need. Generally, not much information on wood, seemingly not enough to design any but a simple building. Of course, concrete and steel get much more attention. Light-framing not discussed.

Timber Design and Construction Sourcebook

Karl-Heinz Gotz, Dieter Hoor, Karl Moehler, Julius Natterer, Peter F. Martecchini
NY: McGraw-Hill
1989

This is the English translation of what remains the classic book on timber design, the *Holzbau Atlas* (Germany, 1978; also published in French as *Constuire en bois*, 1983). While the *Holzbau Atlas* is legendary, it seems that few people know of this English translation. It maintains the original's use of German codes and standards, and most of the many illustrated examples are in Germany or Northern Europe, although there are several buildings from Canada and elsewhere. The book covers wood properties (mostly European woods), fundamentals of wood construction, large halls and roof structures, timber frame (including, briefly, light-frames), wood-panel construction, and some details of different components. The emphasis is mainly on larger buildings and members. The writing is clear, intellectual, and authoritative in a manner only Europeans can muster. Close to 200 buildings are illustrated with great skill, including construction photos, plans, elevations, isometrics, and excellent detail drawings of connections, layering of materials, and so on. The book is directed at architects and their building associates, with a view to the fusing of architectural intentions with engineering needs and construction practices. It contrasts itself with the large body of purely technical literature directed at engineers, and focuses on the aesthetics of timber design in which the structure is often exposed, and where changes in member size and execution lead to direct changes in appearance.

Structural Design in Wood, 2nd ed.

Judith J. Stalnaker, Ernest C. Harris
NY: Chapman & Hall
1997

This seems to be one of the good textbooks in the field, aimed at engineering (and architecture) students. The authors teach the basic principles of structural design through the medium of wood, and also demonstrate a range of real-world design problems. A focus is made on structural planning and the paths of load transfer. Simplified explanations of wood properties and design calculations, along with examples, exercises, and design tables, make this useful for the student. Mostly discusses wood properties and products, and member and connection design, with only brief information on different types of structures. This second edition adds an explanation of load and resistance factor design (LRFD) alongside updates on allowable stress design (ASD), making it the only book to cover both methods.

Timber Construction for Architects and Builders

Eliot W. Goldstein
NY: McGraw-Hill
1999

Recently published, this is one of the better books on this subject. Well-researched and written in a clear, approachable manner, the terminology is simplified and explained in non-engineering terms, and the book includes only essential mathematical information. It contains an unusual amount of practical information, and, unlike other books, gives information on timber specifications for architects, as well as estimating and bidding, shop drawings, and timber erection for builders. Other chapters cover the usual topics such as wood properties, codes, framing, fasteners, trusses, and lateral bracing. Additional chapters cover traditional joinery and its revival, and covered wood bridges, the latter as case studies for maintaining, evaluating, and restoring existing timber structures. An excellent chapter is a very detailed case study of a building the author designed, and oversaw the construction of, from conception to program, design, choice of materials and members, costing, and construction. This book does not cover light-framing at all, focusing on heavy timber and glulam design.

Principles of Timber Design for Architects and Builders

Don A. Halperin, G. Thomas Bible
NY: Wiley
1994

According to the authors, "this book has a pragmatic approach, utilizing logic and reasoning to obtain first approximations to sizes of structural members rather than providing some mysterious trial size tendered by an author... [and it] strives to cover completely the most common types of timber construction while not drifting into engineering esoterica." Despite these good intentions, it is still pretty technical, like a text book, with many tables, graphs, and diagrams. In its lack of images, this book would probably be unattractive to architects, and technically beyond what most builders really need to know or care about. Despite its recent date it works on the assumption of sawn lumber, except for the usual engineered wood products like glulam and plywood which have been around more than fifty years.

Simplified Design of Structural Wood, 4th ed.

Harry Parker, James Ambrose
NY: Wiley
1988

Organized and written as a primer in structural design, with the examples dealing specifically with wood structures. It claims to be for "those persons with limited training in mathematics and engineering analysis [including students and] the many young architects and builders who desire a guide for home study." Explains loads, stresses, design values, capacities, fastenings, diaphragms, etc. for wood. The book also gives two simple full structure design examples to demonstrate actual calculations. There is more engineering in this book than that required for a typical house, or by a typical builder.

Limit States Design of Wood Structures

F.J. Keenan
Toronto: Morrison Hershfield
1986

"This book has been written to assist students and engineering practitioners to design wood structures using the limit states design (LSD) method... As a textbook, it sets out to explain the fundamental behaviour of wood-based structural products when exposed to service conditions and loads; as a design manual, it provides charts and graphs which can bring about efficiencies in the design process." This book is based on the first (1984) CSA Standard for LSD in wood. Thorough and well-written, with good background material on wood, products, systems and LSD itself. It does not go very far into light-frames, just an overview and discussions of typically engineered members within light-frame construction, such as trusses and beams. The coverage of heavy timber design is much more detailed.

ASD: Allowable Stress Design Manual for Engineered Wood Construction

American Forest & Paper Association, American Wood Council
AF&PA /AWC
1999

Similar in intent to the CWC *Wood Design Manual*, this is however published in modular format in a binder, and uses ASD instead of LSD. Includes a short introductory manual with case studies and the description and design procedures and formulae for types of members and connections. The National Design Standard for wood construction, its supplement and commentary are all included as separate modules. Other modules deal with the general description, design values, and tables for metal connectors, trusses, structural composite lumber, I-joists, glulam, structural use panels, structural lumber, etc. Since many wood products are now proprietary, this manual often directs the reader to manufacturer's literature, and the acceptance reports for particular products prepared by code authorities. Seems useful and well-organized. Other industry associations contribute to specific modules, including the CWC, APA, WWPA, etc.

LRFD: Load and Resistance Factor Design Manual for Engineered Wood Construction

American Forest & Paper Association, American Wood Council
AF&PA /AWC
1996

The partner (or competitor) book to the ASD manual by the same associations, this is also published in modular format. The organization is the same as the ASD manual, and includes a short introductory manual with case studies (the same case studies!) and the description and design procedures and formulae for types of members and connections. The AF&PA/ASCE standard for LRFD in wood, and its commentary are included in the main introductory manual. The accompanying modules deal with the general description, design values, and tables for metal connectors, trusses, structural composite lumber, I-joists, glulam, structural use panels, structural lumber, etc. Since many wood products are now proprietary, this manual often directs the reader to manufacturer's literature. Useful and well-organized. Other industry associations contribute to specific modules, including the CWC, APA, WWPA, etc.

Timber Construction Manual, 4th ed.

American Institute of Timber Construction
Englewood, CO: The Institute
1994

The necessary concepts, processes, formulae, and values, for design in sawn lumber and glulam (and not other wood products). Begins with design considerations, physical and mechanical properties of wood, before describing the standard practices for designing specific members in allowable stress design. "Information of an engineering textbook nature, such as derivations of equations, is not included since the purpose of the Manual is to present data for design and construction application by those familiar with engineering procedures."

Timber Design Manual, Metric Edition

Laminated Timber Institute of Canada
Ottawa: The Institute
1980

The formulae, charts, and tables necessary for design in timber, particularly glulam. There is no real textual description or information included. Still widely available in libraries, and probably used a lot in its time. we suspect this has largely been superseded by the CWC's *Wood Design Manual.*

Introductory Timber Design with the Canadian Code

B.N. Thadani
Winnipeg: Cantext
1984

"This is the first textbook on timber design based on the Canadian Code and is intended for both students and engineers." This has been superseded by the Canadian Wood Council books and also predates limit states design (LSD). Still gets borrowed frequently from UBC's library. Clearly written, but rather out of date.

Timber engineering : practical design studies

E. N. Carmichael
London: E. & F.N. Spon
1984

Not abstracted. A guidebook for engineers written specifically to address UK standards.

Structural timber design

Abdy Kermani
Oxford: Blackwell Science
1999

Not abstracted. A recent guidebook for engineers written specifically to address British standards and the Eurocode. Includes a chapter on the use of the computer program Mathcad in timber design.

Wood Structures: A Design Guide and Commentary

American Society of Civil Engineers
NY: American Society of Civil Engineers
1975

While somewhat old, this still seems to be a thorough and useful guide to engineering with wood. Chapters on wood properties, components, and products give an overview of the history of engineered testing with an extensive (pre-1975) bibliography. Chapter on structural systems focuses on how "building construction is systems oriented, with compatible systems correlated and intertwined to form the whole structure. Thus, wood foundation systems and wood construction go hand in hand… In wood construction, wood and wood-base materials support each other." Notes that light wood frame construction has typically been un-engineered, but that changes in the industry will see more engineering involvement with product development and testing, and through structural design with engineered and machine stress rated (MSR) wood. Predicts future light-frame construction will see a mixture of conventional construction practices and engineered elements like trusses and beams. Does represent some practices which would be frowned upon today, such as wood sills directly next to concrete.

Design and Construction of Wood-framed Buildings

Morton Newman
NY: McGraw-Hill
1995

A pretty dry book filled mostly with examples of design calculations, plus some diagrams and plans, aimed at showing engineers with book knowledge some practical experiences in designing with wood. Chapters are briefly introduced with technical backgrounds. The same author's *Structural Details For Wood Construction* (1988) has not been abstracted.

Builders' Manual

Canadian Home Builders' Association
Ottawa: CHBA
1995

As a builders' manual, this book is unusual in that it does not present step-by-step directions on how to build a house; a certain amount of building knowledge is assumed. Rather, this manual really focuses on the prior planning and the multitude of details necessary, in different types of construction with different materials, to create a sealed and efficient building envelope and mechanical system. After chapters on general building science and design considerations, it covers items like siting, layout, window and door location and type, barriers and insulation, windows and doors, the implications of many different mechanical systems, indoor air quality, and energy/environmental issues. The final chapters look to the house of the future, and suggest both the complexities and efficiencies possible with the systems now being developed for controlling interior environments.

Efficient Wood Use in Residential Construction

Ann Edminster, Sami Yassa
Washington: Natural Resources Defense Council
1998

"A practical guide to saving wood, money, and forests," this book is targeted at house designers. Well-done and thorough treatment of six ways to use less wood without radical design changes: 1) trusses and panels to replace on-site stick framing; 2) stressed skin panels; 3) optimum value engineering; 4) reclaimed wood; 5) job site waste reduction; and 6) durability detailing. Lays out construction details, benefits, limitations, product dealers and information sources for each category. The occasional sidebar quotes from builders are a gesture at conveying the practical experience side of these otherwise academic recommendations (i.e., the book doesn't stand on its own, as designers would need further help to implement the strategies). Strong push for FSC-certified wood even though authors indicate cost is higher and there are no wood volume savings; thus, inclusion in the book is only justified on a "save the forest" basis. Engineered wood products are not included due to the use of "toxic glues." Also, OSB is flagged as a potential indoor air quality problem regarding formaldehyde, although stressed skin panels (which nearly always use OSB) are strongly advocated. Steel and concrete are not offered as alternates to wood due to lack of clarity on their environmental impact.

Builder's Guide: Mixed Climates

Building Science Corporation
Westford, MA: Building Science Corporation
1997

One of four builders' guides published by this consulting firm for the different climate zones of North America. Clearly written in a matter-of-fact tone. Wood is stated to be the best framing material with recognition of its limitations. Briefly discusses efficient use of wood, and mentions some uses of engineered wood products in framing. This guide concentrates on how to build a tight envelope and ventilate it properly, so most information and diagrams relate to sealants, sheathing, insulation, etc.

Residential and Commercial: Design/Construction Guide

APA-The Engineered Wood Association
Tacoma: APA
1998

One of a long and varied list of publications put out by this association detailing the use of engineered wood products. This particular publication informs the builder or designer how to select and specify the products, and describes how the products are used in floor, wall, roof, and panel system construction. Construction details are clearly illustrated, and some tables of nailing schedules, required panel thicknesses for certain applications, etc., are included. For further APA publications, many of which include technical design data, visit their web site (see web sites section).

Old House Measured and Scaled Detail Drawings for Builders and Carpenters

William A. Radford
NY: Dover
1983

A modern reprint of the 1911 text *Radford's Portfolio of Details of Building Construction.* Possibly useful to a present-day renovators, although structure does not get covered in great detail. Most of the book is devoted to details of window surrounds, fireplaces, porches, interior woodwork, etc. The few structural drawings reveal either brick supporting walls, traditional heavy timber joinery, or true balloon frame construction. The latter, while commonly illustrated in this book, is mildly denigrated as being the "cheap" type of construction.

Building Construction: Materials and Methods

H.G. Miller
Toronto: Macmillan
1980

A high school text book to introduce and help prepare students for the building trades (not including plumbing, electrical, etc.). Clearly written, with quite good illustrations, this book mainly focuses on wood frame house construction. It also covers concrete foundations and pre-cast components, metal trusses, masonry veneer, and so on, to lesser extents. Somewhat out of date today, but good for the basics.

Wall Framing

Charley G. Chadwick, Thomas S. Colvin, George W. Smith Jr.
Athens, GA: American Association for Vocational Instructional Materials
1989

One of (no doubt) many textbooks for beginner's level construction courses for vocational or technical schools, this book focuses on specific techniques for the selection of materials, and the framing, erecting, squaring, and sheathing of wood walls on top of a floor platform (floor framing covered in a separate companion text). Easy language and good illustrations, plus study questions and definitions.

Basics for Builders: Framing and Rough Carpentry

Scot Simpson
Kingston, MA: R.S. Means Co.
1991

Written by a framer for (especially beginning) framers, this book is almost entirely illustrations of tools, nailing patterns, and step-by-step layout and construction processes for framing of floors, walls, roofs, and openings. Additional chapters cover costs, codes, and management. Makes things fairly clear, but does assume the reader is apprenticed to an experienced framer.

House Framing

Jack P. Jones
NY: McGraw-Hill
1995

Written by a builder in a matter-of-fact tone directed at other builders, apprentices, and also do-it-yourself or weekend project people. Definition of framing actually begins with excavation and foundations, and covers all portions of building to dry-in stage (sheathed and roof felted). Covers concrete and permanent wood foundations equally, but the framing itself is all wood in this book, specifically sawn lumber and panel products. Seems to be one of the most detailed of the books oriented to builders and takes into account some of the recently developed wood products and connectors. Includes some basic span tables and typical load calculations.

Carpentry in Commercial Construction

Byron W. Maguire
Carlsbad, CA: Craftsman
1988

A relatively rare (if not unique) book devoted to nonresidential wood construction for builders. It is directed at carpenters who are expanding their expertise from residential to nonresidential construction, particularly as foremen or site supervisors. The book deals with the differences between the two types, mainly in the greater necessity in nonresidential construction for planning, scheduling, coordinating and directing activities, training apprentices, and procuring materials. After an overview, the author covers formwork, framing, roofs, and exterior/interior finishing. Describes tasks step-by-step, but actual construction techniques are only in summary form; that is, it does not delve into specific wood detailing techniques. Covers wood structural design data and minor engineering calculations to give a general knowledge.

Platform Frame System of Construction

Canada Mortgage and Housing Corporation
Ottawa: CMHC
1979

A thin publication which gives a very general description of the concept, elements, sequence of framing, timing of the other trades, and overall versatility of the platform-frame method of house construction. It is aimed at the layperson considering construction of a house.

Building the Timber Frame House: The Revival of a Forgotten Craft

Tedd Benson, James Gruber
NY: Charles Scribners' Sons
1980

This is the classic in the field of traditional timber framing and its modern-day revival. Presents a short history and makes many good arguments for the revival, before going into planning and building a new timber frame house. The book spends most of its time on joinery, assembly, and raising, using detailed drawings and photographs, but also includes basic engineering calculations and tables for beam design. There is a later edition (1989), as well as a second book by Tedd Benson that has not been abstracted, *The Timber-frame Home: Design, Construction, Finishing* (Newtown, CT: Taunton, 1997).

Post-frame Building Design

John N. Walker, Frank E. Woeste
St. Joseph, MI: American Society of Agricultural Engineers
1992

An edited volume of papers presenting the state-of-the-art in this type of wood construction which uses buried poles as the main structural members. The papers are devoted to engineering topics like loads, deflection, diaphragm analysis, and the properties of the poles and other building elements. Considerable data and standards included in the appendices. Probably the key volume for this building method popular for farm buildings and residences.

Truss-framed Construction

Forest Products Laboratory, USDA Forest Service
Washington: National Association of Home Builders
1982

"A manual describing a new approach to designing and building light-frame structures, developed at the Forest Products Laboratory... because of the need for economical, high-quality, disaster-resistant framing systems." For each bent or bay, the floor, wall, and roof support is designed as a single unit, with the studs extending from the bottom chord of the floor truss to the top chord of the roof truss, thereby tying everything together better than in platform-frame construction. The bays are prefabricated on the ground and tilted up into place. As far as we know, this method has never caught on in a big way.

Wooden Houses

Judith Miller
NY: Stewart, Tabori & Chang
1997

Purely a coffee-table book, and could not be used as a technical reference. Wood construction is described in a superficial manner, with generalizations and historical inaccuracies. Generally, this a poorly organized book, with text and relevant photos separated by several pages, and with historic and contemporary buildings confusingly juxtaposed. The book is pretty much about aesthetics of wood, and therefore focuses largely on interior finishes and details. Some great photos of beautiful buildings, though.

The Owner-built Pole Frame House

Barbara Kern, Ken Kern
NY: Charles Scribner's
1981

Argues for the use of pole framing for inexpensive, solid, and materials-efficient houses. Describes the process of building one with an odd combination of advanced technology and traditional values—for example, construction glues used to assemble lumber that you have logged, milled, and treated yourself. The authors argue that typical modern house framing is ridiculously overbuilt as prescribed by codes, and they advocate applying for zoning variances and ignoring codes when non-compliance is possible. The book is political, but straightforward, and the techniques of building seem sound. Gives a sense of the house as an environmental system, to help the self-builder plan siting and design.

Wall Framing

Elizabeth Williams, Robert Williams
Blue Ridge Summit, PA: TAB
1989

"A complete reference for the home handyman," mainly describing renovations and additions to existing houses, although the photographs actually show full house construction. Wood framing is assumed, and some common species are discussed briefly. Begins with the basics of what tools you need and how to construct a sawhorse. Poorly illustrated and not well written, so not as useful as the publications by government and national builders' associations.

Articles

Designing wood-frame condominiums

Peter Berton
Canadian Architect
34:3
1989

This brief article cautions architects that designing and building 3-storey wood-frame condominiums is not identical to building a really big house. Assumes ignorance of architects and builders on this issue. Remarks on the implications of wood shrinkage being magnified due to building's size, and suggests the solution of hanging joists from the walls. Also offers ideas for noise separation in these multi-unit wood-frame buildings.

LRFD for engineered wood structures: connection behavioural equations

Thomas E. McLain, Lawrence A. Soltis, David G. Pollock Jr., Thomas L. Wilkinson
Journal of Structural Engineering
119:10
1993

"A new design specification for engineered wood structures has been proposed in load and resistance factor design (LRFD) format. This paper provides an overview of the proposed LRFD connections design criteria. The connection design provisions are, in part, calibrated from allowable stress design provisions. Major changes from historic practice, however, result from a change in behavioural equations to a theoretical base for predicting the lateral strength of connections using bolts, screws, and nails... The LRFD document contains substantial improvement in code clarity, simplification, and structure over the historic allowable stress specification. A clear mechanism for including design with new wood-based engineering materials is provided."

Architectural challenges and opportunities for incorporating wood in the design of buildings

Sebastian Butler
Wood Design Workshop
6 Oct. 1997, Vancouver

This is perhaps the most informative of several presentations recorded in this binder from a workshop organized by UBC Wood Science and the BC Network for Wood Building Design and Construction. This article, by the architect responsible, details the design process, program, wood engineering, etc., of the new Wood Science buildings at the University of British Columbia. Other presentations from this conference include general overviews of wood design in Europe and Canada, plus papers on connections, seismic design, software, durability, and fire protection.

Insuring noise control in wood-framed buildings

J.B. Grantham, T.B. Heebink
Forest Products Journal
22:5
1972

"Practices that reduce the expected sound insulating properties of a wall or floor [system] are described and illustrated from field test experience." Shows architects and builders how to prevent sound transmission in wood-frame buildings by designing details to prevent leaks and flanking. Prevent leaks by planned placement of objects embedded in party walls (not back to back), drywall extending floor to ceiling, insulation of mechanical, etc. Shows ways to prevent flanking between joists, through crawl spaces and ducts, as well as structure-borne noise.

Traditional timber framing today

Rudy R. Christian
CRM: [bulletin]
20:12
1997

Describes Timber Framers Guild of North America and its Traditional Timberframe Research and Advisory Group. These groups are a clearing house for information on all aspects of non-engineered timber framing and joinery.

Basic timber framing exposed

H. Weber Wilson
Old-house journal
5:2
1977

Shows historical construction methods of hand-hewn timber houses of the Colonial era in North America.

Hands-on repair of house sills

John Leeke
Old-house journal
20:2
1992

Synopsis of types of wood-frame house construction common in North America since 1800, with a view to structural repairs. Briefly describes construction process, pros and cons, and terminology. Followed by two articles on wood substructure repair including posts, joists, and sills.

Fine Homebuilding

Individual articles not abstracted

Since it is about building and renovating houses, a high percentage of articles in this quality journal are about wood and timber framing, light-framing techniques and details, and wood finishing materials. New products such as panel systems get reviewed as well. Each issue is filled with tips and techniques, from the specific to the general, including information on tools, project and business management, how-to for speciality designs, and illustrated building reviews. There are many articles on wood as a material: preservative treatments, glulam timbers, grading, and so on. Advertisements reflect the wood bias as well.

Design Data

Books

Canadian Lumber Properties

Canadian Wood Council
Ottawa: Canadian Wood Council
1994

This book "provides engineers, architects, scientists and code developers with a source of information on the structural properties of Canadian softwood lumber derived from full-size ("in-grade") tests…[It] provides a discussion of sampling, testing and analysis procedures; a summary of statistical information for bending, tension, compression and modulus of elasticity of visually graded dimension lumber; detailed analysis of size effects, property relationships, moisture content and rate of loading effects for Canadian in-grade data; and an assessment of the tension and bending properties of machine graded dimension lumber."

Wood Structural Design Data

National Forest Products Association
Washington, DC: NFPA
1986

First published 1934. "A manual for architects, builders, engineers, and others concerned with wood construction." Brief introductions and definitions are followed by extensive tables of design data for the following topics: properties of structural lumber, beams, columns, plank and laminated floors and roofs, and floor joist spans.

Guide to Wood Design Information

Wood Products Promotion Council
Kenner, LA: Southern Forest Products Association
1994

This is probably the most useful bibliography for our interests in wood construction, although it should be noted it lists only U.S. sources. It lists texts and manuals, and all pertinent associations and items they have published, such as technical design literature, architectural design pictorials, case studies, A/V material, etc. Most importantly, the listing of technical design literature published by the various associations is extensive: for example, span tables, construction details, grading rules, use manuals, standards, and code commentaries for different products and elemenis. Since this type of literature is outside the parameters of our study, it is useful to be aware of this list.

Western Woods Use Book, 4th ed.

Western Wood Products Association
Portland: WWPA
1996

In module format in a large binder, this presents structural data and design tables for western woods, with brief chapter introductions for different structural members or products.

The Wood Book

Paul Griffin
Montgomery, AL: Hatton-Brown
1990

A strange mishmash of Canadian and American wood propaganda, including dimension lumber and engineered wood products data tables, illustrated reviews of recent wood buildings, and advertisements. Not sure who was behind putting this out, but it was an annual for some years.

Wood Detailing for Durability

Books

Builders' Series: Wood-Frame Construction Problems

Canada Mortgage and Housing Corporation
Ottawa: CMHC
1989

Purports to be aimed at builders, but is a little technical at times, such as when it dives into equilibrium moisture content on the first page. It is arranged in a troubleshooting manner, but does not give solutions to problems that have already occurred and need fixing. Rather, this guide shows what should not be done in construction. It is preventative rather than restorative. Uses metric exclusively–do builders? Drawings sometimes difficult to understand.

Builders' Series: Moisture Problems

Canada Mortgage and Housing Corporation
Ottawa: CMHC
1988

A useful reference material for builders and homeowners, as it diagrams good construction practices for prevention of moisture problems, and it also offers solutions for fixing problems on existing buildings without completely rebuilding. Written clearly, and divided into sections based on building components. There are several other books in this series on specific topics like siding, preserved wood foundations, and roof flashing, that have not been abstracted.

Wood: Detailing for Performance

William A. Dost, Elmer E. Botsai
Mill Valley, CA: GRDA
1990

The authors advise on and illustrate proper detailing for the prevention of meteorological and biological decay based on their experiences in wood design. This book is aimed at the designer who needs to specify the exact nature of the detailing, and therefore does not discuss structural design. Framing is discussed only where there are details that need to be designed for structural members to resist decay and failure, or if the framing affects the performance of the building envelope. The focus is on exterior finishing and envelope details.

Defects and Deterioration in Buildings

Barry A. Richardson
London: E & FN Spon
1991

"The purpose of this book is to assist architects, surveyors and engineers to recognize, diagnose and avoid problems in buildings." In fact, this rather dry British book is not well-suited to practitioners trying to solve a problem, due to highly technical language, lack of illustrations (contains just a few pages of photos showing—not very clearly—examples of problem buildings), and emphasis on fundamental principles. More of a textbook than a guidebook. Even the promised diagnosis tips are buried in heavily scientific text regarding moisture, thermal, noise, etc., transmission. As a textbook, however, seems quite thorough.

Wood-Frame Envelopes: Best Practice Guide

Canada Mortgage and Housing Corporation
Ottawa: CMHC
1999
CD-ROM included.

Quite a thorough and practical guidebook, containing a nice collection of large-scale and extremely well-developed design details (also in AutoCAD™ on the CD-ROM), as well as specification text for the drawn details. Also includes a small amount of background material on wood science, heat transfer, moisture transfer and moisture control, all to the appropriate level of depth and in understandable language.

Wood-Frame Envelopes in the Coastal Climate of British Columbia: Best Practice Guide

Canada Mortgage and Housing Corporation
Ottawa: CMHC
1999
CD-ROM included.

A climate-specific version of the more general CMHC best practice guide for wood-frame envelopes (see above listing), this has greater emphasis on moisture control. Background information on wood science and moisture control is substantially beefed up. Another change is presentation of various wall and window assembly approaches shown in diagrammatic section drawings, where the air barrier, moisture barrier and vapour barrier functions are all indicated, as well as a suggestion of expected performance of each approach as a function of exposure risk. This guidebook therefore encourages more thinking on the part of the user than the purely prescriptive alternate version above. Includes exceptionally well-developed design details (also in AutoCAD™ on the CD-ROM), however, does not have sample specification language as with the alternate version. Instead, supplies extensive information on components and materials to assist in development of specifications.

Structural Use of Wood in Adverse Environments

Robert W. Meyer, Robert M. Kellogg
NY: Van Nostrand Reinhold
1982

An oft-cited collection of papers from a 1978 Vancouver (Western Forest Products Laboratory) conference. This book comprises a broad selection of papers on the use of wood, from very specific laboratory research results, to practical field observations of failures and practices. Many of the authors were asked to prepare a summary and extensive bibliography of research in their field. The topics run the gamut from overviews of moisture, temperature, weathering,

and other effects on components and structures, to introductory papers on limit states design, to case histories of repairs and renovations. The three chapters are as follows: adverse environments and related design considerations; structural design and evaluation; evaluation of residual strength and repair of structures. Probably still a useful book for designers of wood structures. (Individual articles not abstracted).

Evaluation, Maintenance and Upgrading of Wood Structures

American Society of Civil Engineers
NY: American Society of Civil Engineers
1982

This book focuses on rehabilitation of older wood buildings, and in the process covers past practices and regulations, and factors which influence the performance of wood buildings over time. Chapters on inspection, evaluation and repair, are supplemented by generally useful chapters on maintenance of wood structures and designing to avoid problems in wood structures. Includes several descriptive case studies of rehabilitations.

Classic Wood Structures

American Society of Civil Engineers
NY: American Society of Civil Engineers
1989

Presents case studies of twenty buildings and seventeen other structures constructed from wood, and still standing as fine examples of the material's durability, versatility, and beauty. Most of the structures are North American, although Norwegian stave churches and an ice rink in Switzerland are also included. This book is fun and useful, as it is part history and part engineering, and also relates recent rehabilitation procedures for many of the structures, in which engineering plays a role in preserving the historic structure.

Wood Protection Guidelines: Protecting Wood from Decay Fungi and Termites

Wood Protection Council
Washington: National Institute of Building Sciences
1993

"Intended to provide information and guidance to builders, architects, engineers, specifiers, do-it-yourselfers, students, and private and federal agencies," this thin handbook is a rather incomplete collection of poorly organized bits and pieces. Background material is better covered in other literature, while the few design details would be found with more development in builders' manuals. Contains some useful tips on which wood elements should be pressure-treated (or naturally durable), as well as some information potentially helpful in writing specifications (for example, in noting various treated wood standards), but both are buried in the user-unfriendly formatting.

Architectural Opportunities Seminar

F. Alan Tayelor
Vancouver: Forintek Canada Corp.
1981

Comprises six papers that were presented at this seminar directed at educating architects in the decay hazards and proper uses of wood. The papers cover the biology of decay, problem areas in wood construction, preservative treatments, foundations, enclosures (vapour barriers), and general good practices for architects specifying wood. The style is approachable. The papers do not go into great detail or use many examples.

Survey of Building Envelope Failures in the Coastal Climate of British Columbia

Canada Mortgage and Housing Corporation
Ottawa: CMHC
1996

Initiated in response to large scale moisture failures in low-rise wood-frame residential buildings in BC, this study reports on 46 buildings. Major conclusion is that the main source of water is exterior (versus condensation of vapour from the interior or construction moisture). Most problems are found at interface details between wall components or at penetrations. A variety of other causes are also identified, including lack of overhangs, poorly detailed drawings, construction errors and so forth. Neither a survey nor a field study, the work is lacking in scientific rigour and the report is thin (for example, methodology section does not make it clear that most data came from existing files of the

researchers). Nonetheless, it is one of the only studies of its kind and the conclusions are fairly well grounded by the technical background and field experience of the authors.

Comparative Analysis of Residential Construction in Seattle, WA and Vancouver, BC

Canada Mortgage and Housing Corporation
Ottawa: CMHC
1999

Report on field observations of four buildings in Seattle, to determine if any differences in design practice between these two climatically-similar cities lead to different performance in low-rise wood-frame envelopes. No useful observations beyond the 1996 BC survey, other than an identification of heavier regulations on the building industry in Seattle, although no causal relationships are identified on this point.

Moisture Control in Buildings

Heinz R. Trechsel, Editor
American Society for Testing and Materials
Philadelphia: ASTM
1994

Contains 26 papers, mostly academic in nature, across a full spectrum of issues from fundamentals to case studies. Like similar publications, this hopes to be a reference manual for the building industry and homeowners, but would almost certainly fail due to highly technical non-graphic content and the single-issue focus. Thus, this book suffers the split personality problem of others in its attempt to convey useful, practical information and also serve as a reporting of state-of-the-art research. Editor notes moisture control is not a mature science, and many knowledge gaps exist, along with disagreements among the experts. A few papers might be useful to other researchers, and overall not a bad documentation of moisture knowledge and research for 1994, but otherwise the application and audience of this book unclear. One standout paper is G. Tsongas' survey of existing case studies of moisture problem buildings.

Moisture Control Handbook

Joseph Lstiburek, John Carmody
NY: John Wiley & Sons
1994

This book is an update of a 1991 softcover guide (same authors and title) published by the Oak Ridge National Laboratory's building envelope research program. Focus is on residential construction. Addresses moisture control principles and practices for the US, broken down by three broad climate zones. Probably considered a pre-cursor to Lstiburek's subsequent four-zone Builder's Guide series, where he takes the basic science here and delivers prescriptive and practical information via heavier use of drawings. This book contains quite a lot of building science, in clear language and well-illustrated. A good textbook.

The Renewal of Trust in Residential Construction

Dave Barrett
Victoria: BC Ministry of Municipal Affairs
1998

The report of findings by the provincial Commission of Inquiry into British Columbia's "leaky condo crisis" based on 29 public hearings and 730 written submissions. The commission found fault at every stage of the design and construction process, implicating nearly all players in the broad building industry. The first report on the BC crisis to give a voice to homeowner victims, which lends an emotional character to the document. Nonetheless, an interesting and well-done analysis (although perhaps non-scientific) of the complex problem of moisture failures in BC in the 1980s and 1990s. Addresses the multiple causes of the problem and recommends a plan of action.

Articles

Technics: wood protection detailing

Gerald E. Sherwood
Progressive Architecture
73:8
1992

"Presents detailing criteria to avoid decay in wood-frame buildings," including flashings, basements, siding and roof overhangs, porches, and ventilation. Notes that popular styles in architecture often do not consider proper protection detailing. Refers to upcoming publication on the same topic (see Wood Protection Council, 1993).

Earthquake-proofing wood buildings

C.C. Sullivan
Architecture
86:3
1997

This article points to code reviews and research resulting from recent California earthquakes, and states: "wood-frame buildings survive earthquakes when shear walls, framing connections, and bracing are designed to maximize seismic durability." Refers to requirements for these design details, and to anchoring cladding, proper nailing, and structural detailing of interruptions such as stairwells.

Performance of stucco-clad wood-frame buildings in a temperate rain forest

Marcus J. Dell, Sean B. Liaw
ASTM Special Technical Publication
n.1314
1998

"This paper is a case study of severe deterioration that has occurred due to water ingress and resultant fungal attack at a condominium in Vancouver…The causes [of these problems] are numerous, including: poor waterproofing membrane application; improper flashing terminations; and substandard stucco application." The repairs of this building are described, and the authors make recommendations on materials and proper detailing to prevent decay.

Rain control and design strategies

John Straube, Eric F.P. Burnett
Journal of Thermal Envelope and Building Science
23
1999

"This paper develops a rational means of describing, understanding, and classifying rain control for the above-grade enclosure. The manner in which walls and roofs actually control rain in service is then discussed." Attempts to fill in the gap of no theory for rain control as there is with other areas of envelope physics such as heat flow, vapour diffusion, etc. Presents a mathematical model that describes the movement of rainwater striking a wall. Also includes scientific descriptions of different envelope approaches to rain control (face seal, rain screen, etc.). Much too esoteric for a designer, this paper is aimed at envelope performance researchers, perhaps especially modellers. Included here for its well-considered and rigorous examination of the theory which is (appropriately) not included in rain control design guides.

Restoring structural wood

Martin E. Weaver
Construction Specifier
43:7
1990

"The article discusses a systematic approach to restoring or repairing an old wooden structure. To understand how wood has behaved and is behaving in an old structure—a prerequisite to restoration—one must know which species was used and how durable it is. Other subjects covered include wood deterioration agents and mechanisms, timber defects surveys, restoration techniques, and others."

Failure of the building envelope: two case studies

Richard Ogle, John O'Connor
Thermal Performance of the Exterior Envelopes of Buildings VI, 4-8 Dec. 1995, Clearwater Beach
Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers
1995

Two northern Alberta, Canada rural hospitals with envelope failures were examined, one of which was wood-frame and was exhibiting decay of sheathing, corrosion of steel supports, deterioration of shingles and staining of stucco. Typical of the few field studies that exist in that the number of buildings observed was small and conclusions rest heavily on past experience of the researchers. In this case, researchers identified cause of problems in a combination of faults in the original design-construction process and the post-occupancy building operation. One consequence was major air leakage, which resulted in condensation that was the source of moisture for decay. Paper also includes detailed descriptions and drawings of the remedial repairs.

Tri State Homes: A case study of extensive decay in the walls of older manufactured homes with an exterior vapor retarder

George Tsongas, James Olson
Thermal Performance of the Exterior Envelopes of Buildings VI, 4-8 Dec. 1995, Clearwater Beach
Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers
1995

A major manufacturer of pre-fab homes in Wisconsin, Minnesota and Michigan went bankrupt over widespread failure in many of its homes. This paper reports on investigation of 21 such homes, 19 of which had plywood decay, 12 of them severe. This field survey has one of the largest sample sets of any reported studies on envelope failure. In this case, the source of moisture was condensation of vapour originating indoors in combination with a low permeability building paper. As with similar case studies, the authors rely somewhat on past experience to validate conclusions on the current study. However, they take a step further and additionally validate their conclusions with computer simulations. The authors call this one of the first cases of extensive wood decay in North America, which is especially notable because the climate for these homes is not considered conducive to decay.

Moldy houses – building science lessons from the Wallaceburg project

Mark D. Lawton
Thermal Performance of the Exterior Envelopes of Buildings VII, 6-10 Dec. 1998, Clearwater Beach
Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers
1998

"Thirty-nine houses with high levels of biologically active contaminants in Wallaceburg, Canada, and 20 houses with low levels of biologically active contaminants, were subjected to field inspections and testing, monitoring of indoor environmental conditions, and simulation to predict the condensation formation potential in winter. Occupant health was evaluated through questionnaires and blood sampling from an index child for analyses of T-lymphocyte and B-lymphocyte structure. We found that low air leakage and natural ventilation were not associated with higher measures of mold growth. Analyses found that moisture sources in the houses were a more significant factor in mold and dust mite antigen levels than relative humidity. Visible mold area was not a good predictor of ergosterol concentrations, indicating that hidden mold growth may be a factor. This paper addresses the influence of house construction characteristics on the levels of mold growth." Although a fairly rigorous study, conclusions rely somewhat on the opinions of the author, a well-known engineer in the field.

Temperature and moisture performance of wall assemblies with fiberglass and cellulose insulation

William B. Rose and David J. McCaa
Thermal Performance of the Exterior Envelopes of Buildings VII, 6-10 Dec. 1998, Clearwater Beach
Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers
1998

This field study in a single building aimed "to determine the effect of various vapor protection measures on preventing or reducing the sheathing moisture content and incidence of mold growth or loss of structural strength in the non-insulating sheathing." Rose has done previous work examining history and performance of vapor barriers, important components in wall assemblies affecting the durability of wood products. Interesting as an example of field test methodology, as there exists no standard for this. No strong conclusions from this study.

Drying capabilities of wood-frame walls with wood siding

Mikael H. Salonvaara, Tuomo T. Ojanen, Erkki Kokko and Achilles N. Karagiozis
Thermal Performance of the Exterior Envelopes of Buildings VII, 6-10 Dec. 1998, Clearwater Beach
Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers
1998

One example of several papers at this conference describing hygrothermal analysis of wall systems using a combination of limited laboratory experiments and computer simulation. Illustrates that moisture performance of envelopes is an immature science, in that researchers are still establishing the early building blocks of knowledge, test methodologies, etc. Describes approach, correlation between laboratory and simulation data, and an attempt to apply a mold growth equation to the computer calculations. Emphasis is on method, not on conclusions other than suggesting that wall cavity ventilation may be important.

Research/Testing/Innovation

Books and Reports

Earthquake Performance and Safety of Timber Structures

Greg C. Foliente
Madison, WI: Forest Products Society
1997

Although it is a conference proceedings, this publication has the advantage of several plenary papers which give a broad, useful overview of their subjects, which include: an introduction to earthquake danger, earth movement and historical timber seismic solutions; the state of light-frame seismic design; code issues; and the state of research in modeling and analysis for timber structures. In shorter papers, current research projects and earthquake reconnaissance studies are described.

Performance of Wood-frame Construction in Earthquakes

J. Hans Rainer, Erol Karacabeyli
Vancouver: Forintek Canada Corp.
1999

"This report presents a survey of the performance of wood-frame construction in a number of recent earthquakes... The survey shows that despite some specific shortcomings and resultant failures, a majority of wood-frame buildings of various ages... survived the shaking without serious structural damage or collapse and with very few resulting injuries and deaths...The few observed failures and collapses could be traced primarily to specific instances of lack of lateral bracing, weak first storey, inadequate connection to foundations and the fact that the observed ground motions far exceeded the then-existing design requirements. The observed shortcomings have been, and are being, addressed by researchers and practitioners in order to eliminate these adverse effects in future earthquakes. The research program at Forintek Canada Corp. is highlighted. Finally, for existing buildings that do not meet current seismic standards, guidelines available in the USA and Canada for screening, evaluation and upgrading are presented."

Light-frame Wall and Floor Systems

Gerald E. Sherwood, R.C. Moody
Madison: Forest Products Laboratory, USDA Forest Service
1989

Sections within the overall chapter divisions of structural performance, fire safety, and living environment concerns, present a historical overview of the research conducted into specific elements of wall and floor systems by the Forest Products Laboratory and many other agencies around North America. The point is to explain methods of predicting the performance of different systems, and also to show how the research has affected codes and design practices. Based on a 1981 conference, this publication has extensive bibliographies of the research reports.

Frame Construction Practices and Material Survey in British Columbia

F. Alan Tayelor
Vancouver: Western Forest Products Laboratory
1975

This is a research report of field survey results, intended to inspire the wood products industry to form better connections with the building industry. Two survey crews spent thirteen weeks in the summer of 1972 on construction sites in British Columbia. The objectives of the survey were to: 1) understand the application of wood products in typical light-frame construction, with a particular eye towards labour-saving or cost-reducing techniques; 2) catalogue quantities, grades, species, sources, wastage, finish material and other quantitative data of the building process; 3) collate and report on subjective information obtained from building crews, site supervisors, suppliers, development managers and field survey crews; 4) provide supplementary information through interviews with manufacturers of structural components, modular units and mobile homes. Other than a different distribution of species and products, these rich findings bear remarkable resemblance to sentiments today. For example, discoveries include: a wide range of product quality; wide differences in builders' knowledge, opinions and operational procedures; criticisms of inspection and approvals systems; reluctance to adopt change; and extremely poor communication between the wood products industry and the building industry.

A Profile of Wood Use in Nonresidential Construction

Henry Spelter, Robert G. Anderson
Madison, WI: U.S. Dept. of Agriculture, Forest Products Lab (Resource Bulletin FPL 15)
1985

Summarizes a survey of architects and contractors to determine the frequency of wood use in nonresidential buildings. The survey is split up by building type, size, and element, by US geographic area, and by wood product. Some comparison is also made with amounts of other materials used for different building elements. In general, wood use declines with the increasing size of buildings, and is lower in the southern U.S. Wood is most common in roof framing and decking, partition walls, and floor joists. Infers quantities of wood use through interviews, then compares results with census numbers of building types and manufacturer statistics of production. Concluding discussion points to lack of familiarity with wood use, specification, costs, and codes, and to questions of quality, as barriers to increased use of wood, particularly in the larger nonresidential buildings.

Wood Used In New Nonresidential Building Construction 1995

Wood Products Promotion Council
1998

This is an update, using the same type of statistics and a similar mode of analysis, to Spelter and Anderson's 1985 survey under a similar title. The present survey relied on the research of a market research company into materials usage in nonresidential buildings in 1995 (as opposed to the in-house phone survey method of the previous study).

A Literature Review of Wood Use in Nonresidential Construction

Robert A. Kozak
Vancouver: UBC Forestry
1992

Focuses not on construction, but on issues of economics, statistics, specifiers' education, etc. None of the reviewed literature is useful for information on techniques of wood-frame construction, but this bibliography is worth noting.

Articles

Advanced wood-frame construction details in Canada

Avi Friedman, Vince Cammalleri
Building Research and Information
24:5
1996

Aimed at the designer, this article begins with some interesting statistics showing how building failure is most often related to detailing, particularly in the building envelope. Describes the concepts of air and vapour barriers, and

numerous methods of detailing them, especially at joints and openings in the walls. Concludes with analysis of the energy savings afforded by detailing for tight (R-2000) and very tight construction detailing.

Modeling of a wood-framed house

Ajaya K. Gupta, George P. Kuo
Journal of Structural Engineering
113:2
1987

"A simple [mathematical] model is presented for analysing wood-framed houses subjected to lateral forces from wind and earthquake." Begins with a brief literature review of previous tests of built. full-scale houses, back to the first conducted in 1957 by the National Research Council of Canada, but concentrating on the Tuomi and McCutcheon (1974) full-scale house built at the Forest Products Laboratory of the U.S. Forest Service, on which the present study bases its modelling analysis. The authors suggest that their modelling method could be used to approximate the behaviour of buildings.

System reliability and load-sharing effects in light-frame wood construction

David Rosowski, Bruce Ellingwood
Journal of Structural Engineering
117:4
1991

This paper was intended as a contribution to the development of load and resistance factor design (LRFD) criteria by the wood industry. It is based on an analytical model for a light-frame floor assembly and accounts for duration-of-load effects and their importance in reliability analysis. Compares data with other studies of finite elements and computational methods for determining LRFD values performed at the Forest Products Laboratory, Forintek, and for the National Building Code of Canada.

Lateral load sharing by diaphragms in wood-framed buildings

Timothy L. Phillips, Rafik Y. Itani, David I. McLean
Journal of Structural Engineering
119:5
1993

"A full-scale single-story wood house is constructed and tested under lateral loads and various stages of loading... Different sheathings, fastener arrangements, and openings are incorporated to create shear walls with varying stiffness." Includes literature review of other full-scale built tests. An additional objective was to provide detailed measurements for use in the development of analytical models.

Non-linear finite element model of complete light-frame wood structures

Bohumil Kasal, Robert J. Lechti, Rafik Y. Itani
Journal of Structural Engineering
120:1
1994

"A light-frame wood structure is an assemblage of several components such as walls, floors, and roof, joined by intercomponent connections such as nails or metal plates. Behaviour of a full structure reflects the interactive behaviour of the individual components and connections. Whereas individual substructures have been investigated both experimentally and analytically, individual substructures and components of a light-frame wood building have never been incorporated into a full-structure model. This research provides an analytical method to investigate the behaviour of light-frame wood structures loaded by static loads." The authors compare the findings of their analytical model to an actual full-scale house test.

Seismic weaknesses of some residential wood framed buildings: confirmations from the 1994 Northridge earthquake

Andre Filiatrault, Chris K.A. Stieda
Canadian Journal of Civil Engineering
22:2
1995

"The damage observed during the Northridge earthquake...is used to illustrate the need to introduce engineering concepts in the seismic design and retrofit of residential wood structures. Typical mitigation procedures to strengthen and increase the earthquake safety of wood buildings are discussed." Notes that Canadian standards for design of wood buildings are far behind those for designing steel and concrete buildings in the aspect of seismic safety. The structural wood weaknesses noted at Northridge included foundation anchorage problems, failures due to cripple walls and soft storeys, and the inadequate connection of wood framed roof assemblies to masonry construction walls.

Wind resistance of conventional light-frame buildings

Ronald W. Wolfe, Ramon M. Riba, Mike Triche
Hurricanes of 1992: An ASCE Symposium, 1-3 Dec. 1993, Miami
NY: American Society of Civil Engineers
1994

"Evidence strongly suggests that the extent of damage resulting from Hurricane Andrew was not due to an inherent weakness in light-frame wood construction...Failures were primarily due to misapplication of connections and missile damage rather than inadequate code requirements...Damage surveys suggest the need for critical review of light-frame building construction methods and inspection procedures." Post-disaster observation found problems with roofing, roof sheathing, uplift on roof overhangs, and lack of connection (creating system redundancy and stiffness) between interior partition walls and exterior bearing walls. This paper was in a conference session devoted to residential construction, which also included papers on damage and resulting code changes from Hurricane Iniki in Hawaii, a discussion of codes for wind load, and the performance of metal plate connected wood truss roof systems during Andrew.

Dynamic response of timber frames with semi-rigid moment connections

Y.H. Chui, C. Ni
7th Canadian Conference on Earthquake Engineering, 5-7 June 1995, Montreal
Ottawa: Canadian Association for Earthquake Engineering

A fairly limited study of two methods of connection in a glulam post and beam laboratory assembly subjected to earthquake loads. Attempts to apply conclusions to timber frames in general. This paper is typical of those in the proceedings of earthquake engineering conferences which usually focus on connections or shear walls.

Performance of low-rise timber buildings subjected to seismic, wind, and snow loads

Lawrence A. Soltis
ASCE Conference Preprint
American Society of Civil Engineers
83-015
1983

Summarizes statistics collected after various natural disasters in the late 1960s-70s in relation to wood-frame buildings. They generally performed well, except in cases of severe loading when faults in lateral bracing, connections, or engineering occasionally occurred. Points reader to literature describing better engineering practices.

Impact of using a system factor in the design of light-frame roof assemblies

P.V. Mtenga
Forest Products Journal
48:5
1998

"A light-frame roof assembly was analysed [using] system factors...Different assembly configurations, obtained by varying the assembly span, truss spacing, and the dimensions of the lumber in the top and bottom chords, were

analysed…The application of system factors resulted in significant reductions of the quality of material required to satisfy a specific structural configuration…[which] will indirectly imply a reduction of the redundancy built into the current design of light-frame roof assemblies. It is thus recommended that the use of the system factor should be accompanied by concerted efforts to improve quality control in the production and handling of trusses."

Effect of openings on the stiffness of wood-frame walls

Y.Z. Ge, V.S. Gopalaratnam, H. Liu
Forest Products Journal
41:1
1991

"A study simulated the effect of window or door openings on wood-frame walls. The method proposed considered the contribution that the wall areas above and below openings give to wall stiffness and its racking resistance; this parameter was incorporated into a simplified shear wall model. Using this method, a slight overestimation of the stiffness of a wall with openings was observed. This was attributed to construction flaws normally associated with wood-frame construction." The article suggests taking account of these construction flaws in design. This paper is good for its literature review of previous wall tests of this sort.

A conventional house challenges simulated forces of nature

R.L. Tuomi, W.J. McCutcheon
Forest Products Journal
25:6
1975

A small house was constructed in the laboratory and tested against simulated live loads. Racking resistance proved more than adequate despite the conventional un-engineered construction. Systems of connections were weak links under excessive (unnatural) loading. One of the first tests of an entire structure.

Moisture movement and control in light-frame structures

G.E. Sherwood, A. TenWolde
Forest Products Journal
32:10
1982

In the light of energy conservation measures of recent years, building envelope tightness and insulation have resulted in moisture concerns. This article is a "review of moisture damage to structural components and control measures to reduce condensation." It concludes that the most effective method remains maintenance of reasonable indoor RH levels, along with vapour barriers in appropriate places.

Rain leakage in wood-frame buildings: two case histories

D.L. Scott
Building Research Note
Ottawa: National Research Council of Canada
1984

Presents the author's research at two problem buildings in Atlantic Canada whose owners complained of moisture in walls and heating inefficiencies. The two buildings, a single and a multi-family dwelling, were built in 1955 and 1967 respectively. Diagrams show wall construction as found by the author. Rain leakage was determined to be the problem in these two cases.

How specifiers learn about structural materials

Robert A. Kozak, David H. Cohen
Wood and Fiber Science
29:4
1997

The justification, methods, summary, and discussion of a large survey in Canada and the U.S. performed by the authors "to determine how specifiers (architects and structural engineers) learn about building materials." This article focuses on certain aspects of the survey including: educational background, promotional methods that work with specifiers, and their willingness to explore other materials. Where appropriate, the authors split up the responses

between architects and structural engineers. Recommends lobbying universities for curricula changes, and suggests methods for promoting wood use to certain audiences.

Evolution of the insulated wood-frame wall in Canada

N.B. Hutcheon, G.O. Handegord
DBR Paper (No. 946)
Ottawa: National Research Council of Canada, Division of Building Research
1980

Summarizes the history of wood-frame wall construction with particular emphasis on the role of research into insulation, air barriers, claddings, and materials. Shows how economic and technical changes have altered products and their uses in construction.

Current Housing Research

Individual entries not abstracted

This is published a couple of times a year so that researchers can see the types of research being funded by the Canada Mortgage and Housing Corporation. It briefly describes research under way and as yet unpublished on the social, economic, and technological aspects of housing in Canada. For example, the recent issue lists work on British Columbia building envelope problems, and on new materials, designs, and components.

Canadian Building Digests

Individual papers not abstracted

Published on an irregular basis from 1960-1990 (now ceased) by the Institute for Research in Construction of the National Research Council of Canada, these are brief papers outlining current knowledge of specific building topics such as moisture problems, building codes, wood shrinkage, new materials, and the implications of particular techniques. As a research source, they are most commonly available in indexed volumes of fifty collected digests.

Moisture movement in building enclosure wall systems

John F. Straube, Eric F.P. Burnett
Thermal Performance of the Exterior Envelopes of Buildings VI, 4-8 Dec. 1995, Clearwater Beach
Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers
1995

These researchers at the University of Waterloo have operated an outdoor test building (the "beghut") since 1989, and they report here on general methodology for controlled field testing as well as some results from monitoring more than 30 different wall panels in the beghut. Excellent guidance for others planning similar research efforts.

Architects and structural engineers: an examination of wood design and use in non-residential construction

Robert A. Kozak, David H. Cohen
Forest Products Journal
49:4

The justification, methods, summary, and discussion of a large survey in Canada and the U.S. performed by the authors to assess the market environment for wood structural products in non-residential buildings. The most rigorous study to date examining specifier behaviour in material selection, however, focus of the work is on promotional opportunities for wood products manufacturers.

Examples of Wood Buildings

Articles

Modernizing timber design

Jim Taggart
Canadian Architect
44:11
1999

This feature article is a call for Canadian designers to start using wood in a creative, modern manner and celebrates a few Canadian projects that display what the author sees as progressive wood design. The author first looks to Europe for good examples of wood design, and refers to European advancements in building codes and technology—specifically Computer Numerically Controlled (CNC) wood cutting machines. Light-frame construction appears in one of the Canadian projects highlighted. Structural design and technique are not delved into, as the article focuses mainly on building program, symbolism, comfort and aesthetics.

Research buildings 2: working in wood

Bronwen Ledger
Canadian Architect
41:6
1996

Brief building description delves into different wood products used in Forintek's Eastern Research Laboratory. No detail drawings. Typical building review.

Forintek western research lab

Len Ward
Canadian Architect
36:1
1991

Showcases this building with photographs, plans, and detail drawings with commentary. The text fully describes the program, intentions of client and architect, structural and code considerations, the various wood products used, as well as why, where, and how they were used. Quite in-depth for a building review.

Wood

Pilar Viladas
Progressive Architecture
64:6
1983

In a section entitled "Materials How To," wood gets a couple of pages along with all other materials, here in specific reference to renovation. "How To" is a misnomer, as these articles are purely descriptive.

Wood in architecture

Roger Yee
Progressive Architecture
56
1975

Theme issue on wood buildings. Introduction looks mainly at the state of forests in the U.S., gives a historical overview of forest use, and discusses the development of engineered wood products. Followed by building reviews, typically focusing on architectural program and symbolism, but they do list the different materials used.

Wood spirit

Peter Davey
Architectural Review
201:1199
1997

British journal commonly available in North America. This article introduces a theme issue on recent wood buildings, and points to the "psychological importance" of trees and wood, which will ensure wood's continued use in its original form and as engineered wood products. The preciousness of wood is stated within the context of waste at the levels of arboriculture and construction. The theme issue includes many of the famous recent wood buildings such as the Museum of Wood (Japan), the Henley Rowing Museum (UK), and the Fishbone House (Galiano Island). These are heavily illustrated, but their discussion does not go into structure and materials very much.

Cutting it, ethically

Jay Thompson
World Architecture
37
1995

One more article from a British journal with an international perspective, that uses Forintek's Western Laboratory as an example of the possibilities and advantages of building in wood. Also mentioned are recent high-profile designs in glulam for London and Lisbon. The article is mostly about embodied energy, and the great advantages of wood products over other building materials, as shown by recent British research.

Structure both concealed and revealed

Sheri Olson
Architectural Record
184:5
1996

Discusses unusual structural designs and the complications of getting contractors to build them with unusual methods. Wood is key to solving this problem because of its flexibility and familiarity to contractors. Exemplified in three famous buildings by Patkau Architects which are briefly described in their use of materials and illustrated with details.

Rethinking the wood house

Mark Alden Branch
Progressive Architecture
75:5
1994

Begins by noting the importance of wood construction in American domestic architecture. Focuses on two architect-designed homes for which were developed a new window and a new plywood cladding system. The architect, Jonathan Levi, advocates turning wood into an urban material (like the other materials are known as) by building higher, and with great detail for durability. The architect's own, painstakingly detailed, six-storey wood house is an example.

Across the grain: a university building offers lessons in detailing wood

Douglas E. Gordon, M. Stephanie Stubbs
Architecture: the AIA journal
79:4
1990

A particular project (Alumni House, University of Connecticut) is examined for its use of wood and its architects offer suggestions regarding choice of wood type, and the importance of designing and testing details before handing plans over to clients or builders.

Wood working

John Prendergast
Civil Engineering (NY: ASCE)
65:5
1995

In an issue devoted to materials in this non-technical engineering magazine, there is an article on timber construction which case studies four buildings that used glulam. Three of the four were only timber roof structures. This piece is similar to an architectural journal article, but building reviews in engineering magazines generally contain more statistics related to sizing of members, and to the speed and cost of construction, as well as discussion of structural design, foundations, and maintenance requirements (see next entry as well). Very positive towards wood in non-residential structures.

Swimming in style

Gary Steficek
Civil Engineering (NY: ASCE)
66:8
1996

Describes the design of a swimming pool/gym facility for a college from the engineer's standpoint. The glulam roof structure and its galvanised steel connections are described in detail. Glulam was chosen for the roof over other materials due to its beauty and ease of maintenance in the humid environment. The rest of the building is concrete and brick construction.

Wood works in distinctive applications

Maureen Rosengren
Building Design and Construction
36:12
1995

Two architects discuss wood libraries they designed and note that competitive prices and visual appeal make wood an attractive option for many buildings. Codes and ease of installation are also highlighted.

Wood Design and Building

Individual articles not abstracted

Showcase publication for wood architecture begun in 1997 by a spin-off of the Canadian Wood Council. The bulk of the magazine is reviews of select wood buildings. These featured buildings are well illustrated with photographs of construction and the finished product, architectural drawings, connection and other pertinent details. Accompanying text always discusses the specific wood products used in the building and briefs the reader on building code implications of the project; details of structure, materials testing, etc., are also sometimes discussed. The magazine also publishes regular reviews of specific wood products, systems, techniques, and other aspects of building with wood. The first pages include wood design news and a letters section for technical questions from readers which are answered by experts in the field.

Wood le Bois

Individual articles not abstracted

Published by the Canadian Wood Council since 1992, this is essentially a thinner, traditionally less international, bilingual version of *Wood Design and Building* (above). Articles, particularly building reviews, are often duplicated exactly. Also includes news briefs and technical notes. Tends to have less technical information than its sister publication.

Architectural Digest
Metropolitan Home
House Beautiful

Individual articles not abstracted

These popular home magazines are a dead end for real information. When they talk about wood it is purely as finish material, and is all about show and appearance. Lots of illustrations of wood interiors.

Web Sites

Canadian Wood Council

www.cwc.ca

An excellent site offering news and a lot of information about wood construction, including detailed case studies of actual built projects. Free and for purchase, downloadable software for designing with wood, span calculations, and code checking are all available. Offers a technical assistance hotline/e-mail. Describes the many CWC publications which can be ordered, and the educational opportunities offered by the Council, including courses, fairs, and teaching kits. For consumers it offers advice on remodelling and home purchase, and facts about wood and wood use.

National Association of Home Builders

www.nahb.org
www.nahbrc.org

The sites for this huge association and its research centre describe their activities advocating housing and house construction in the U.S., and their research on housing, economics, and building materials and methods. Through various initiatives, the NAHB attempts to bridge the gap between its research arm (and relevant research from elsewhere) and the builders, housing designers, and others who are members of the organization. Among other programs and publications, builders are disseminated information through continuing education offered by the affiliated Home Builders Institute. Information for consumers is also provided on the site, with articles on topics like remodelling, buying a new house, negotiating with builders, etc. The NAHBRC also operates the Research Home Park, a "suburb" of built homes which are designed to test specific materials or design theories. These research homes, and the in-house publications list offered in the online store, reflect extensive research into alternative materials, particularly panel systems, as well as steel framing and concrete units. Their information on steel, in particular, has a promotional tone to it.

Canadian Home Builders' Association

www.chba.ca

"Information for homebuyers and homeowners from Canada's housing experts." This site is mainly directed at the consumer, so it does not contain technical information on construction, though it links to a site about the R-2000 environmental building methodology. Information for builders includes links to provincial apprenticeship training programs, and a job/worker search database.

Canada Mortgage and Housing Corporation

www.cmhc.ca

A great site for information on housing, particularly the social and economic aspects of housing, the building industry, and home ownership, as well as national and international markets for housing. The CMHC's technical research is made available in html and .pdf formats. These technical reports deal mainly with very specific details of construction or the building envelope, though recently many broader studies of the "leaky condo" problem have also been undertaken. This site links to the Canadian Housing Information Centre, the repository and document delivery service for all the research (and publications) the CMHC has done in the past, as well as of research by many other organisations, with other links included.

Canadian Centre for Housing Technology

www.ccht-cctr.gc.ca

Describing the purpose, organization, partnerships, and research of this centre which is sponsored by the National Research Council of Canada, Natural Resources Canada, and the Canada Mortgage and Housing Corporation, and is devoted to research into the house as a whole system, and to healthy houses. "The Centre currently features two fully monitored test homes and a unique demonstration and showcase facility. In the future the Centre will work with industrial partners to develop new research houses and explore specific test and research challenges." At present, research findings and technical information are not provided.

Western Wood Products Association

www.wwpa.org

Much news and economic information regarding western forestry and wood products. Very extensive is the "WWPA Online Technical Guide," which provides all sorts of design values and data for western woods as downloadable .pdfs. As well, the Guide gives information on different species, grading, specifying, environmental issues, and on machine-stress rated and finger-jointed lumber.

APA-The Engineered Wood Association

www.apawood.org

This site describes the association, its activities, its members, and their products. Gives general information on the many types of engineered wood products and their various uses. Case studies show actual uses and describe the reasoning and design behind use of the products. Available for viewing or download are a large variety of design guides, builder's tips (sheathing installation, nailing schedules, etc.), engineering bulletins (design values, stresses. etc.), case studies, research reports, special publications (disaster reconnaissance studies), and other technical information on the use of engineered wood.

American Wood Council

www.awc.org

The wood products division of the American Forest and Paper Association (AF&PA) maintains this site with news and information on the use of wood in building and the implications of building codes on wood design. There is not much technical information on the site itself, but the Council's many publications on wood design and building are available for purchase/download, including its ASD and LRFD design manuals (abstracted above) and several guides to wood-frame construction. Also describes Continuing Education for professionals offered by the Council in the form of the Wood Design Seminar, and links to a few university continuing education opportunities.

American Institute of Timber Construction

www.aitc-glulam.org

A rather poor site with almost no information, dead links, and under construction signs that have been there since 1997. Provides order form, but no descriptions, for the Institute's various publications, including standards, guides, and technical bulletins.

Structural Board Association

www.sba-osb.com

A site dedicated to OSB: what it is and how it is used (if you can find the correct links for the latter topic). Makes available for free various bulletins, pamphlets and guides with design information.

Canadian Plywood Association

www.canply.org

Describes association and its activities. General product descriptions are supplemented by detailed information on specific items produced by the many member companies. Two key industry publications, the *Plywood Handbook* and *Plywood Design Fundamentals* are available for download. Other than this, there is little technical information.

Institute for Research in Construction, National Research Council of Canada

www.nrc.ca/irc

Describes present research pursued by the Institute, which is not on wood-frame construction per se at this time, but rather focuses on building envelope studies, fire prevention, indoor air quality, and urban infrastructure. Searchable database of all Institute (and its predecessor, the Division of Building Research) publications back to 1947. Links to the Canadian Codes Centre, which monitors and updates the National Building Code, and to the Canadian Construction Materials Centre, which produces the serial Registry of Product Evaluations. The NRC web site also links to the searchable library database of CISTI, the Canadian Institute of Science and Technology Information.

U.S. Forest Products Laboratory

www.fpl.fs.fed.us

This site describes the purpose and work of this U.S. Department of Agriculture laboratory which has performed extensive research on wood-frame construction since 1910. Current research is described, and numerous publications on wood properties, prevention of decay, paints and finishes, glulam, etc., are available for free download. The entire text of the *Wood Handbook* can also be downloaded or searched by keyword on this site.

American Society of Agricultural Engineers

www.asae.org

This site makes available several Society publications on wooden farm buildings (mainly post or pole frame), standards, their monthly journal, and links to other agricultural sites. The invention of the pole-frame building has been designated a historic landmark by the Society.

American Institute of Architects

www.aiaonline.com

A very large, constantly updated site with very substantial information for architects, builders, and potential clients, including news, reports, jobs, commission leads, continuing education, etc. Active discussion groups, products and manufacturers, publications, and searchable technical notes and firm listings. Unfortunately, firms cannot be searched by a specialty in timber design, only by building type, but otherwise a useful site.

The Housing Zone

www.housingzone.com

A commercial web site devoted to all aspects of building, buying, and inhabiting housing. Extensive, cross-referencing search engine for building products and manufacturers. Mostly, this site offers current news stories from a wide variety of sources on housing, including design, building, materials, codes, systems, new products, and on other issues like affordable housing, green building, legislation, economics, etc. Previous stories are archived. While the stories are not typically technical, they present a fair bit of information useful to specifiers and builders.

Building Online

www.buildingonline.com

A commercial site whose main attraction is a database and extensive listings for finding web sites of building product manufacturers.

4specs.com

www.4specs.com

"The primary focus for 4specs.com is to provide fast and reliable access to manufacturers' web sites. You can access and use their information about their "specified" products for your projects. Now hot-linking to over 3,434 manufacturers' web sites, 240 trade associations, and related organizations." One of the larger commercial listings.

Building Materials and Wood Technology Dept., University of Massachusetts-Amherst

www.umass.edu/bmatwt

A quite useful site ostensibly describing the undergraduate degree program and courses in this department, but also providing a significant amount of information of interest to an outside audience. A long list of detailed articles on various aspects of building in wood are made available on this site, as well as a useful page of links to other sites. A unique feature is "Ask the experts," where anyone can e-mail a question to one of the faculty members on either the economics and marketing of wood or the technical design and properties of wood structures.

Appendix

A short history of wood building in North America

In early English, "to timber" meant "to build" (Addy, 1933). This intrinsic relationship between wood and building dominates the history of architecture, particularly in North America. In pre-colonial times, the First Nations across the continent erected a variety of wood buildings including Iroquois longhouses and elaborate West Coast post and beam structures. Early North European colonists brought with them traditional building methods using log construction and heavy timber framing[1], and adapted these to the North American climate, and to the species and abundance of wood that they found here.

Many heavy timber framed structures from the colonial era survive to this day in the Eastern portion of the continent, attesting to the craftsmanship of the builders and to the durability of the material. Wood was used for houses, barns, churches, commercial buildings, and mills—plus any other structure necessary to the early settlers. In the case of industrial buildings, as well as in the growing cities where fear of fire was justified, heavy timber structures and wood finishes were often hidden behind masonry exterior walls. Heavy timber building was a highly skilled, labour-intensive undertaking. Hand tools were used for logging, squaring, sizing, and planing timber, as well as for carving the connections where the heavy timber members joined to each other in the structure. In traditional joinery, the end of a member was carved into a tenon, or projection, fashioned to fit into a corresponding mortise, or cavity, in the next member. These joints were further secured into place by the insertion of a rounded wooden dowel, or a hand-made iron nail or spike.

As the frontier spread west across North America, settlers continued to use wood to house their families and businesses, and continued to experiment with new modes of construction. Also, different immigrant ethnic groups brought and developed new techniques of wood construction, and borrowed ideas from each other. When the mid-western United States was settled after 1800, the sudden and massive influx of people, the dearth of both skilled carpenters and large size hardwood timber, and recent advances in industrial technology, all combined to generate a new wood building method which became known as the balloon frame (likely from the word, *bouillin*, which seems to have meant log, or piece of wood, in North American French) (Cavanagh, 1997).

The advantages of the balloon frame were its use of simple nailed joints to make connections between members, and its use of lighter (or thinner) timber members made available by the expansion of steam powered saw-milling, and the 1814 invention of the circular saw (Noble, 1984). The long thin vertical members (studs) extended uninterrupted from the foundation sill to the rafters, and horizontal members were hung from this vertical skeleton using simple wood supports and lots of nails. The light pieces of wood could be handled by one person, and the simplicity of nailed joints allowed unskilled workers—usually the settlers or farmers themselves—to construct a house quickly and cheaply without hiring a master carpenter. Alternatively, it provided the opportunity for an experienced builder to erect and sell many houses in the period of time taken to frame one in heavy timber. As a famous architectural historian wrote:

> *The balloon frame is closely connected with the level of industrialisation which had been reached in America. Its invention practically converted building in wood from a complicated craft, practised by skilled labour, into an industry.*
> (Giedion, 1941).

The same historian quotes a nineteenth century commentator who noted that, if it were not for the development of the balloon frame, "Chicago and San Francisco could never have arisen, as they did, from little villages to great cities in a single year." Milled lumber and nails could be transported easily to growing communities in large rail or boat shipments, and houses, stores, and other building types were constructed of light frames. In the far west during the California gold rush of 1849 another version of the system developed as the western frame—now known as the platformframe. This method altered the balloon frame to allow the builder to complete the ground floor platform first, and then to use it as a work area for erecting one-storey walls on top of the floor. A second platform would be constructed on top of the first-storey walls, with the second-storey walls being assembled and tilted into place on this floor.

Builders migrated between towns and cities cross-pollinating their techniques. For a century, balloon and platform framing—and various versions of them such as braced framing, a sort of hybrid of light and heavy timber framing—co-existed in North America. The different techniques seem to have dominated in different regions, but in truth, as a

1929 publication by the American National Committee on Wood Utilisation concluded, "it is difficult to draw distinct lines between these three types of framing, as modified in actual practice" (Holtman, 1929).

In the same publication, the researchers state that "the western frame today has only a limited use and is not recommended." Notwithstanding, within twenty years, the western platform frame had become the clear choice of builders across the continent. Contributing to its ascendance was a combination of forces which are difficult to analyse, due to a lack of historical research on the subject. Certainly, in the first half of the twentieth century, increasing research by government bodies and lumber companies that promoted the ease of construction and general superiority of the platform frame was disseminated by a continually developing communications media to builders all over North America. In addition, advancements in the plywood industry in the 1940s led to this product's general adoption during the post-war construction boom as floor, roof, and wall sheathing—plywood made the assembly of the platform even more easy, quick, and convenient.

Its early users recognised that the balloon frame derived its rigidity and strength from its entire structural system: studs, joists, blocking, and interior and exterior sheathing, were all integral components for resisting vertical loads and lateral stresses. In the past fifty years, the industry has focused on perfecting the platform frame as a holistic building system, with much research on the integration of structure, materials, connections, fire safety, and mechanical systems.

Log houses maintain their popularity as speciality items, and vertical pole framing has been developed since the 1940s, particularly for agricultural buildings. As well, the popularisation of North American glulam technology, and a backlash against the concrete, steel, and glass architecture of the Modern Movement, has led to a revival of heavy timber construction for houses and for large, nonresidential structures of all sorts. The last twenty years has witnessed the increasing use in construction of newly developed engineered wood products, which have predictable properties, and are often pre-cut or even assembled in the factory. The introduction of these products has been paralleled by increasing interest and involvement in light-frame construction by professional designers who complement the traditional role of the builder. Recently, new structural design methods using computer software and complicated statistical analysis have been adopted for allowing more accuracy and creativity in wood design. Overall, wood continues to play a significant role in the history of North American building.

References cited in the history:

Canadian Wood Council. Wood Reference Handbook. Ottawa: CWC, 1995.

Cavanagh, Ted. "Balloon Houses: The Original Aspects of Conventional Wood-frame Construction Re-examined." Journal of Architectural Education 51:1 (Sept. 1997).

Addy, S.O. Evolution of the English House. London, 1933.

Noble, Allen G. Wood, Brick, and Stone: The North American Settlement Landscape; Volume 1, Houses. Amherst: Univ. of Mass., 1984.

Giedion, Sigfried. Space, Time, and Architecture. Cambridge: Harvard Univ., 1941.

Holtman, Dudley F. Wood Construction: Principles, Practices, Details. NY: McGraw-Hill, 1929.

[1] In the present day, heavy timber is defined as lumber which is 5.5" (140mm) or more in its smallest dimension. This contrasts with dimension lumber used for light-framing, which has smaller width and depth dimensions, one of which is commonly 2" (51mm) (Canadian Wood Council, 1995). The spaces between the heavy timbers of a colonial wall frame were filled with a variety of materials, including wood, brick, and daub, the latter being a mixture of straw and plaster.

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Structural Design in Wood, 2nd ed. *10*
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Structural Engineering Handbook, 3rd ed. *10*
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Western Laboratory

2665 East Mall, Vancouver, BC V6T 1W5
Tel: (604) 224-3221 Fax: (604) 222-5690

Eastern Laboratory

319, rue Franquet, Sainte-Foy, (QC) GIP 4R4
Tel: (418) 659-2647 Fax: (418) 659-2922

Laboratoire de l'Ouest

2665 East Mall, Vancouver, BC V6T 1W5
Tel: (604) 224-3221 Fax: (604) 222-5690

Laboratoire de l'Est

319, rue Franquet, Sainte-Foy, (QC) GIP 4R4
Tel: (418) 659-2647 Fax: (418) 659-2922

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